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THE INTERNATIONAL AERONAUTICAL CONFERENCE AT MILAN

THE history and organization of the International Commission for Scientific Aeronautics, whose name does not indicate that its purpose is to explore the atmosphere, are briefly described in SCIENCE, Vol. XXI., page 461. The fifth meeting of the commission had been appointed for Rome in 1906, but on account of the exposition at Milan, with its aeronautical section, the place of meeting was changed to the latter city. The conference began on October 1 and lasted through the sixth, there being about forty members of the commission and guests in attendance. The proceedings were opened by Professor Celoria, representing the exposition of Milan, and a further welcome was extended by Signor Gavazzi on the part of the municipality, by Professor Palazzo for the Italian government and by Professor Hergesell as president of the commission. Two presiding officers for each session were chosen from among the foreigners present, who were chiefly Germans. England, however, was unusually well represented by four delegates and guests. The writer was the official representative of the United States Weather Bureau, as well as of the Blue Hill Observatory, and on his proposition Dr. O. L. Fassig, research director at the new Weather Bureau observatory on Mount Weather, Virginia, was elected a member of the commission, as were also M. Lancaster to represent Belgium and Signori Gamba and Oddone from Italy.

Professor Hergesell reported on the progress of the work which the commission furthers, since its meeting at St. Petersburg in 1904. In Spain unique observations had been obtained with balloons during the total solar eclipse of August 30, 1905; two expeditions had been sent from France by Messrs. Teisserenc de Bort and Rotch to explore the atmosphere above the tropical Atlantic; in Italy manned and registration balloons at Rome, Pavia and Castelfranco had contributed data, while kites had been employed in the vicinity of Monte Rosa; in Russia the observatory at Pawlowsk was making aerial soundings and other stations were being equipped for this purpose; in Switzerland Dr. Maurer had compared the data on mountains with those in balloons and in Austria numerous scientific balloon ascensions had taken place. In Great Britain and India kite flights were being made and in the United States the government Weather Bureau had joined the Blue Hill Observatory in making kite flights on the term-days. Germany was very active: there were daily observations in the free air at Lindenberg and Hamburg, and in Munich Baron von Bassus and Professor Ebert were experimenting with balloons; the money for a floating observatory on Lake Constance was assured, so that ascents of balloons or kites would eventually be made from a fast steamer; the German Marine had sent a surveying ship, equipped also with apparatus for exploring the air, into the tropics, and the Prince of Monaco, with the cooperation of the speaker, had executed such explorations over the Mediterranean, and over the tropical Atlantic and Arctic oceans. Belgium was now participating in the despatch of *ballons-sondes* and Roumania had promised to cooperate. The cost of publishing these observations executed in the free air, amounting to about 12,000 francs a year, is defrayed by the countries which collect them. General Rykatchef, in reporting on the resolutions adopted at St. Petersburg, stated that it had not been possible to secure the free entry into the different countries of the balloons and instruments which were used in the experiments.

The topics discussed in the subsequent sessions related to the methods of investigation or the results obtained and a summary of the most important follows. Dr. Erk, of Munich, advocated balloon ascensions in the neighborhood of the Alps in order to study local phenomena, such as the föhn wind. Professor Ebert indicated the methods which he employed to determine the deformation of equipotential electrical surfaces around a balloon and showed a new apparatus to measure atmospheric ionization.

The use of small balloons to determine the currents in the high atmosphere was discussed by Dr. de Quervain and others. If a barometer is carried by the balloon from its trace and from the measured angles of the balloon the course can be plotted. A small balloon may be observed with a telescope to a height of ten or twelve kilometers and Professor Hergesell was able in the clear air of Spitzbergen to follow a rubber balloon, which expanded to one and a half meters in diameter, during seventy-four minutes, at the end of this time the balloon being eighty kilometers distant. Micrometric measurements of its diameter showed the velocity of ascent to be nearly constant, since the loss of gas is slight, so that the height when it enters the different currents may be calculated from a single station, even if the balloon carries no barometer or is not recovered. A mechanical triangulating device has been used by De Quervain for finding the height of the balloon, but this is similar to the apparatus which Mr. Clayton devised for

getting the height of clouds at Blue Hill. Colonel Vives y Vich recommended sending up paper pilot balloons simultaneously with the *ballons-sondes* in order to see how the wind changed in the isothermal zone. Baron von Bassus exhibited an apparatus for reading the curves of the self-recording instruments and Dr. de Quervain discussed the thermal inertia of the different thermometers, concluding that the metallic bar of Hergesell was more sensitive than that of Teisserenc de Bort. An interesting discussion followed as to the relative value of observations obtained with kites and balloons, General Rykatchef, Professor Berson and others favoring the former and Professor Hergesell alone championing the latter method.

General Rykatchef, for Mr. Kouznetzof, explained a method that had been employed at Pawlowsk to ascertain the height of clouds at night by projecting a searchlight upon them and measuring the vertical angle of the spot of light, which elicited the information that the same method had been tried in France, at Hamburg and at Blue Hill. Captain Scheimpflug showed how photographs of the ground taken from a balloon could be rectified so as to be transformed into topographical plans.

A number of communications giving the results of observations in the free air were presented. General Rykatchef stated deductions concerning the vertical gradient of temperature in the free air at Pawlowsk, which is greatest near the ground and during the month of June and least in December. Another paper by Dr. Rosenthal discussed the diurnal range of temperature at different heights over the sea. While in the first 100 meters there is a fall of 1° C. in the day and 0.2° at night, in the stratum between 300 and 400 meters the decrease is 0.6° during both day and night.

Mr. Rotch gave the results of the first *ballons-sondes* in America, fifty-three of the fifty-six balloons which he had despatched from St. Louis in 1904–'06, having been recovered. One of the lowest temperatures ever observed (— 79° C.) was recorded in January at a height of only 14,800 meters, and the isothermal, or relatively warm current, which had been found in Europe, was shown to exist at a greater height in the United States. Dr. de Quervain presented proofs of this isothermal stratum above 12,000 meters, which had been furnished by ascents of balloons in the daytime. Professor Hergesell related some experiments which he had made to measure the vertical movement of the atmosphere by getting the difference between the calculated rate of ascent of the balloon and the vertical movement of the air recorded, amounting in one case to a downward current of half a meter per second. Professor Berson offered two papers, one being a discussion of more than a thousand kite flights at Lindenberg, in order to ascertain the variation of wind-velocity with height, the author concluding that the velocity increases faster than the density of the air decreases. The other paper discussed the data from sixteen *ballons-sondes*, sent up from Milan the previous summer, nine of which could be followed in the telescope to a distance of eighty kilometers. Very low temperatures were recorded, and — 64° C. at 12,000 meters corresponded to a change of 100° C., from sea level, or nearly the adiabatic rate. Mr. Dines showed views of the kite windlass used by Mr. Cave and gave an example of a large inversion of temperature observed in England up to 2,000 meters.

The most interesting communications related to the exploration of the atmosphere over the ocean during the preceding year. M. Teisserenc de Bort gave the results of the last cruise of his steam-yacht *Otaria*, which had been sent across the equator by

Mr. Rotch and himself. Thirty-nine pilot balloons were launched and twenty-two balloons with instruments, of which seven were lost. A captive balloon ascended to 7,500 meters and kites were used in the lower strata. The existence on the open ocean of the southwest anti-trade above the northeast trade, and of the northwest anti-trade above the southeast trade, was demonstrated and it was shown for the first time that the temperature high above the thermal equator is lower than it is at the same height in temperate regions, owing to the absence of isothermal strata. Professor Hergesell gave a brief account of the cruise which he had made to Spitzbergen on the Prince of Monaco's steam-yacht *Princesse-Alice*. Owing to fog and cloud no lofty observations were obtained, but a slow decrease of temperature and a rapid increase of wind with height were indicated. Professor Hergesell explained his method of releasing one of the tandem balloons at a given height, so that the other balloon with the instrument would soon drop and be recovered, even in cloudy weather. It was suggested that the balloon might be liberated also by electrical waves. The same speaker and Professor Köppen described the survey steamer *Planet* of the German Marine, which is making soundings of both the water and the air in the South Seas. The thanks of the commission were voted to the German Minister of Marine, to the Prince of Monaco and to Messrs. Teisserenc de Bort and Rotch for their researches over the oceans.

M. Teisserenc de Bort submitted a memoir on the necessity of extending the territory for the international ascensions. In Europe almost all the stations are grouped within an area having less than a thousand kilometers radius, and there are none to the north and southeast. It is necessary to get data from a point to the north of the Scandinavian peninsula and also to the north of Great Britain. It would be interesting to have one station near the center of the Mediterranean, such as the Etna Observatory at an elevation of 3,000 meters. In Algeria it is proposed to launch pilot balloons and to measure their angles, and in Cairo, where there is a well-organized meteorological service, it is probable that observations can be obtained with kites and pilot balloons and possibly with *ballons-sondes*. In the United States we have observations, due to Mr. Rotch, at Blue Hill and at St. Louis and an aerial observatory has been established by the government on Mount Weather in Virginia. The most important place is Newfoundland, where *ballons-sondes* could be launched, even during storms, as the writer, M. Teisserenc de Bort, had done with success in the more restricted region of Denmark. In order to bridge the gap over the ocean, as much as possible, it is proposed to request the Canadian meteorological service to make ascensions with pilot balloons at Bermuda; to have this done at the Azores, and to secure the cooperation of the Jamaica and Havana observatories. In Mexico *ballons-sondes* might be used and the system thus developed will permit the general circulation to be determined at different heights around two or three of the most important centers of action in the atmosphere.

At the close of the meeting eleven resolutions were voted, chief of which were the following: The commission, on the recommendation of M. Teisserenc de Bort, realizing the great importance of collecting sufficient observations to chart the meteorological elements at various heights under different atmospheric conditions, believes that its efforts should be concentrated upon four groups of ascensions during the year, called 'grand international ascensions,' in order to distinguish them from the monthly ascensions. These last are optional for

stations which do not make aerial soundings their chief work. The quarterly ascensions will be made during three consecutive days, on dates to be named hereafter. It is recommended that the trajectories of the *ballons-sondes*, and of the pilot balloons, when only these are used, should be determined by angular measurements and that the same thing be done for clouds. It is also desirable, as General Rykatchef has suggested, to have at least one temporary station for these international observations in the midst of the great Asiatic anti-cyclone, especially in winter. If this can be established the observations should last seven days instead of three days, that is to say, two days before and two days after the normal days.

A subcommission consisting of Messrs. Teisserenc de Bort, Berson, Hergesell, Köppen, De Quervain and Rotch decided to adopt Professor Köppen's proposition to publish a compendium of the best methods of sounding the atmosphere, for which the several establishments actually conducting such investigations will be consulted and the publication made by the International Commission. The subcommission also recommended that a form of publication, similar to that used by the Deutsche Seewarte, be adopted for statistics relating to the kite flights and that a similar résumé for balloon ascensions be used by the institutions participating in them.

The commission expressed its satisfaction that atmospheric soundings had been begun by the United States Weather Bureau on Mount Weather and hoped that they might be extended to other stations of the service.

The conference agreed with Major Moedebeck that it would be useful for scientific as well as for ordinary balloon ascensions, if, on the topographic maps of the various states there should be indicated in red the location of collections of lights which could serve to orient the aeronaut at night, and if the lines of high electrical potential, and also the places which were sheltered from wind, should be marked on the maps.

The propositions of Professor Assmann, relative to the meetings, were adopted in this modified form: The commission shall meet but once in three years, unless there is special reason for assembling earlier. The reunions are intended to consider the organization of the work and to discuss methods and instruments, scientific communications being relegated to the last and only presented then if time allows.

It was the sense of the meeting that the entertainments in honor of the commission should be restricted henceforth and at the present convention they had been mostly combined with technical demonstrations of aeronautical apparatus in the exposition and elsewhere. Thus, on one excursion to Pavia the aero-dynamical observatory of Signor Gamba was inspected. Afterwards the university was visited and a lunch tendered by the municipality. On another excursion to Lake Maggiore, through the courtesy of Signor Mangili, president of the exposition committee, experiments in flying kites and liberating *ballons-sondes* from a steamboat, were attempted, although without much success. After the close of the meeting members of the congress had the opportunity of making balloon ascensions, under ideal conditions of weather, in eight balloons which rose from the exposition grounds and landed not far from Milan, a few hours later.

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THE DANGER OF OVERSPECIALIZATION[1]

IN the ever-recurring discussion of our

[1] Read before the meeting of April 5, 1907, of the New York Section of the American Chemical Society.

methods of education and of our pursuits in life, it has been asserted over and over again that 'this is the age of specialists.'

Is this really so? Does this age create more specialists than former epochs in history? If this be the case, does this tendency keep on increasing, and if so, may it not ultimately impede the higher development of mankind and reduce us to mere automatic machines?

The political economist tells us that division of labor increases and improves production. We also know that in any pursuit of life specialization enables us to more thoroughly master the details of a subject.

On the other hand, we ought to admit that even to-day, truly great men, who have achieved distinction by exercising a beneficial influence on the development of our race, were not merely specialists. They were persons of broad general tendencies, although sometimes their superiority was more accidentally manifested in some special line of work. If, to stave this assertion, I started to mention a list of names, I might possibly omit many men of merit known or preferred more particularly by any of you. But I shall take the liberty of turning my argument, by challenging you to name any truly great man who was merely a specialist in one single small branch of human activity.

That one-sided pursuits are apt to make us very narrow-minded will be conceded by many whose misfortune it has been to have to work or live with people who led such a specialized existence. Even the professional fields of specialized activity may lead to short-sighted pettiness. Andrew Carnegie reenforces my own belief, based on personal experience, when comparing the better class of business men to artists, he wrote: "I have learned that the artistic career is most narrowing, and produces such petty jealousies, unbounded vanities and spitefulness, as to furnish me with a great contrast to that which I have found in men of affairs. Music, painting, sculpture, one would think, should prove most powerful in their beneficent effects upon those who labor with them as their daily vocation. Experience, however, is against this."[2]

This apparent shortcoming of artists may be explained by the fact that as a class they are generally very ignorant outside of their own art, which requires more skill than knowledge, and what is worse, to many of them exact knowledge, which might help to broaden their views, is almost repulsive.

But—to come back to first principles—we ought to consider all pursuits of life from a broad general standpoint. I dare say that human life includes, as its noblest attributes, three fundamental tendencies to which all others converge, directly or indirectly. Indeed, nature prompts us—

First, to develop ourselves physically and intellectually—the latter word including all moral development.

Second, to reproduce ourselves and lend our short existence as individuals for the physical and mental betterment of our race, towards a higher goal of absolute good.

Third, to enjoy life in its material and intellectual comforts as far as the latter contribute directly or indirectly to the two first-named functions. This idea includes naturally the production of wealth and the better use of the same.

Whether we be scientists, philosophers, laborers, artists, merchants, money lenders, beggars or thieves, we all obey those laws which predetermine the ultimate destiny of mankind. Whoever, in some way or another, works in harmony with these dictates

[2] 'The Empire of Business,' Andrew Carnegie.

can not help being a benefactor to his own race and to himself in particular.

No individual whatever can try to divest himself of any of the above-mentioned attributes or functions of life, without jeopardizing in some degree or another the progress of his race.

Let us imagine, for an instant, a society only composed of four distinct classes: one, wealth-producing but vicious; a second, very moral but inactive; a third, very intelligent but bodily weak; while a fourth class would be composed of physical athletes, very stupid. Fortunately for the welfare of our race, in such a heterogeneous society, free intermarriage would tend to offset the one-sided grouping of these abnormal individuals or specialists—to call them by another name—and would bring about more homogeneity for their descendants. Furthermore, education—the great leveler of one-sided tendencies—would prove another active factor for accomplishing this result. When I speak here of education, in its broadest sense, I do not merely limit myself to so-called school education; but I include in this term all influence towards mental development, proceeding from any source whatsoever, as, for instance, self-culture and environment. But, whenever education tends to develop one of our faculties beyond reasonable necessity and to the detriment of other functions, we drift towards mental deformity—a freak; and this in about the same manner as a particular muscle exercised beyond normal requirements will leave the remainder of the body insufficiently developed and out of harmony with the other anatomical parts.

Many fundamental errors have been committed by such men as spoke or wrote of the culture or the civilization of a given nation, without according full importance to above considerations. Moreover, history teaches us that a one-sided or specialized education has been the defect of nations of the past, even to a greater extent than it occurs in our present civilization. Many examples can we give to show that such a one-sided culture was largely to blame for the downfall of at one time powerful races. The Greeks, in their overspecialization of art, neglected beyond measure the study of nature. Had her philosophers steadied their thoughts by giving more attention to the careful observation of natural phenomena, instead of dreamingly searching a solution for all problems by analytical reasoning, they would not have been led astray into casuistry and sophistry and skepticism. The great laws of nature might have opened their minds to a better understanding of equity and rights of man; while now history has to record that even the most progressive and radical Greek philosophers proclaimed chattel slavery as an indispensable institution of society. In the same way, a large part of their literature was devoted to beautifully sounding, well polished sentences, dealing mostly with imagination. The Greek writers, in their search for effect, gave their fancy full play whenever they described the war exploits of their heroes, with the result that they put themselves on record in history as the biggest braggarts in prose and in rhyme.

As another example of one-sided culture let me remind you of the inhabitants of India, who became overawed by the conception of the immensity of the universe, and the relative insignificant smallness of man. Exaggerating this feeling, they too failed to grasp the full meaning of harmony in nature and so neglected to give sufficient attention to the material development of their race. This doomed to stagnation an otherwise very intellectual people; it rendered possible their subjugation under the strong and forceful arm of warlike tribes, morally less developed, but physically bet-

ter adapted for the perpetuation and multiplication of their sturdier race.

In the same way, the Roman empire fell as a result of the wilful ignorance of the true principles of equity; her poorer classes, or vanquished foes, were denied their natural rights by their aristocratic masters. This heterogeneity of the people led to all the excesses which brought about the fall of what once had been a mighty empire.

After the advent of Christianity, the despotic Church of Rome retarded the progress of all Christendom as soon as she tried to specialize all human knowledge, so as to make it agree with her own bible. The result was that long and sad period of the dark middle ages. In the meantime, Saracen and Jew, on the north coast of Africa, or on the Iberian Peninsula, were able to cultivate science less trammeled by a restrictive religion. To their broader activity do we owe it that scientific investigation was kept alive until the day when the dawn of Reformation enabled backward Christendom to resume again the search for truth.

But, even now, our educational system is still much under the chilling effect of that cloud which during the middle ages hid the light of true knowledge. Respectable pedagogues have taken care to hand us down from generation to generation a curriculum which includes most of what formerly was erroneously called *a complete education*. In the latter, ancient literature, holy or profane, has always played a paramount importance. In its program, scant consideration is given to more real modern knowledge which refers broadly to the world we live in, or to the burning questions of the day. I know of many instances where, under the name of liberal education, such an antiquated tuition is still dealt out to the younger generation of both sexes. In fact, many well-meaning persons think that this is the kind of respectable training most desirable for a rich young man of good family and good manners. In reality, such an education is merely an overspecialization of the kind of culture which was meted out to studious sons of patricians some two thousand years ago. For our modern requirements, it is an anachronism, if not a positive danger: a danger—because it is liable to select as standards the undeveloped or erroneous thoughts of antiquity. In many instances, the tendencies of the ancients clash with our more advanced ideas of truth and justice—even if the latter are not always consistently practised by modern society.

The French Revolution encouraged some reforms in this antiquated system of education. But even to-day modern science and modern thought are grudgingly allowed a very small place in the classic curriculum so faithfully defended by some pedagogues. Small wonder, then, if we hear so many respectable people use flowery rhetoric on such inconsistent themes as 'science versus religion,' or, 'science versus art'; as if there were any *versus* possible whenever we speak of science as true science, religion as true religion and art as true art—as if truth were different, whether expressed scientifically, religiously or artistically!

Luckily for the progress of humanity, now and then some young men, less blessed with worldly goods or wealthy parents, and more eager to make a living by their own work and education, have been compelled to give a vigorous kick to the classic curriculum fetish. Some of them decided to take their education 'à la carte'—as President Eliot expressed it so picturesquely. They were compelled to select substantial and up-to-date meals, more suitable to their eager modern appetites; they had to shun the stale and indigestible dishes of education made up in antiquity, to please the palates of bygone times.

Unfortunately, the very cause of this new tendency has carried us so far as to seriously threaten us with the pitfalls of the other extreme.

Furthermore, the fact that scientific learning has found unceasing applications in the production of wealth has fostered the constantly increasing tendency for finding in scientific education or scientific pursuits a mere means of earning a living or making money. This has led into scientific vocations a large number of persons who in their profession expected to find a quick and easier means for making a living, but outside of this stimulant possessed few if any of the qualifications of the true scientist. Impractical in their selection, they deceived themselves by choosing an occupation which less than any other leads to wealth or power. But once having decided to enter a scientific profession, they soon became aware that the call is for specialists, and they were forced to specialize one thing or another by their employers, whether the latter were manufacturers, merchants or even some educational institutions whom they served as teachers.

In accordance with this same tendency we find manufacturers who, themselves without other training excepting what long experience has taught them, blame our colleges, universities or technical schools because they do not turn out graduate chemists who can jump right away into their manufacturing works fully acquainted with all the intricacies of the processes; of course, all this with the prospect of a small salary so as to act in competition with a few able and better paid men who had to sacrifice a lifetime in order to acquire experience.

That greed or ignorance should make such claims is quite natural; but that we should find teachers or students who are willing to admit such abnormal educational methods, and change them into a kind of apprenticeship, is a matter of regret for anybody who believes in education as a means for the healthy mental development of his country.

What is worse, our own way of living shows beyond doubt that we all have undergone, more or less, the effects of overspecialization against which I have come to protest. Too much have we learned to look upon our usefulness in life as depending almost exclusively on the concentration of most of our energies, most of our thoughts, upon a narrow line of specialized action. Without knowing it we drift into a mere routine occupation that makes automatic machines out of us. For all generalities of life which do not fall immediately into our own specialties, we are willing to assume respectable conventionality: We are willing to join the herd of docile and unthinking sheep who are following a leader. In science as well as in politics, we are ready to follow this leader, for better or for worse, as long as we can shift upon him our own responsibilities of thought or action.

Busily burrowing along like moles, in the pursuit of our own little specialties, we are dizzily preoccupied with our specialized routine work. We lose the desire of coming once in a while upon the surface of the earth to take a stimulating look at the grand view of nature and its inspiring entity. Once upon a while, we are rather disturbed in our narrow scientific beliefs when some Curie announces radium or radioactivity, or when some Ramsay upsets our orthodoxy by pronouncing the words: evolution of elements. We get fairly shocked when a Crookes speaks of death of matter.

Just in the same way, after admitting as holy faith that weight and matter are constant or indestructible, some day, somebody may have to rouse the most timid of us and force us into the belief that gravita-

tion, like all other energies, can be modified into any of them, or better perhaps, that gravitation, being the more stable of all energies, is the final energy toward which light, health and electricity tend to change. Who knows but that ultimately a less neglected study of gravitation may allow us a glimpse into the secret of the destiny of our universe?

I admit, many of you will smile at these unorthodox hypotheses or conjectures. Yet, let me ask you: With what methods have we thus far measured any possible changes in weight? We have pinned all our faith, all our beliefs, on a mechanical instrument called a balance. A very delicate method indeed, if judged from our conceited one-sided standpoint of specialists. We are proud if we possess a balance which can weigh a one hundredth of one milligram; we work ourselves into awe and admiration before an instrument such as the one I saw two years ago which can detect a difference of a one thousandth of a milligram. A one thousandth of a milligram! How infinitesimally small such a weight appears to our limited conceptions; and yet, what a ponderous quantity this same weight becomes if we try to compare it with the mass of an electron. Our whole science of chemistry is based on the fundamental law of the conservation of matter as formulated by Lavoisier and accepted by us as an axiom. However, by what means has this law been verified, if not by balances more crude, more imperfect, than that clumsy instrument which can not weigh anything beyond 1/1,000 of a milligram? It is high time that science should discover a more delicate means for determining small weights than a mere mechanical balance; then, but only then, may we be able to demonstrate beyond doubt whether all the assumptions on which we base our chemistry are correct, or whether we simply have been building a whole science on false premises.

While we are at this subject let us continue this act of self-examination. When we speak of the descriptive part of the science of chemistry, when we describe any reactions, any compounds, any laws, we all refer these to phenomena which take place within an abnormally small range of temperature. Lately, Dewar opened our eyes to some unexpected phenomena which occur at very low temperatures; on the other hand, the electric furnace so ably manipulated by our regretted Moissan enabled him to establish many unsuspected facts at temperatures which our imperfect thermometric methods do not allow us to measure accurately. Yet, if we will drop for a moment our one-sided considerations and look upon everything in true proportions, we must admit that the range of temperatures within which we have studied natural phenomena is disappointingly small, as compared with the possible range of temperature of the universe.

Not so long ago, chemists had no better definition for organic compounds than to designate them as those that were produced under the intervention of vital forces; inorganic bodies, on the contrary, were supposed to be made under the influence of ordinary physical forces. We all know since how Liebig and Wöhler disposed of this mistake by the memorable discovery of the synthesis of urea from inorganic bodies. Nevertheless, many of us to-day are prone to think that the more delicate organic bodies, as, for instance, the constitments of the protoplasm, will never be obtained synthetically. These doubters point to the fact that as soon as we try to imitate these subtle, synthetic reactions which take place in the living cell we remain powerless to accomplish anything beyond splitting or simplifying the molecule. And yet, let me ask you, what are the laboratory methods

with which we try to imitate the subtle biological processes? Heating, boiling, distilling, desiccation, precipitation, electric currents, every one of them barbarously destructive methods, with which we blast away at exceedingly delicate compounds: We might just as well try to imitate the melodious music of a Gounod by firing some dynamite cartridges between the delicate strings of a piano!

One-sided as we are, we witness every day of our lives the fact that all vegetation accomplishes its processes of synthesis or assimilation under the indispensable action of light; nevertheless, thus far we have tried very little to avail ourselves of this powerful yet delicate source of synthetic energy. Up till now photochemistry has scarcely been used for any other purposes but the art of photography.

What have we done to utilize the effect of pressure in the study of natural phenomena? Very little, even if we take in consideration some half-hearted attempts in this direction. What are the pressures we dispose of as compared with those which exist in the center of the earth? We hear of mines about one mile deep of which the tunnels are submitted already to such a tremendous natural pressure that their walls snap together shortly after an excavation is made, leaving the miner barely time to get out, so as to save his life. If we calculate the pressures existing at these depths we come to very awe-inspiring figures. But if again, we invoke the sense of proportions, we must recognize that a mine one mile deep is a mere insignificant and imperceptible pin prick as compared to the size of the earth. After such considerations, can we expect to duplicate certain chemical or physical processes which have been going on under tremendous pressures in the bosom of the earth? Or shall we try to find means to enormously increase the pressures of which we have thus far disposed in our laboratories, and have considered sufficient, although they are absurdly small.

And how about the element of time in chemical reactions? We all now are aware of the fact that even an explosion of dynamite takes an appreciable and measurable time. On the other hand, Berthelot, in his memorable studies on estherification, has demonstrated that in some cases it requires sixteen years of continuous action before the limit of estherification is reached and a final equilibrium is maintained. We are not inclined to patiently study reactions which take months or years, and yet, in the great laboratory of nature, phenomena are accomplished just the same whether their fulfillment requires seconds or æons. But in our lives, which are of such an infinitesimal shortness if compared with eternity, we look at everything according to the very short lapse of time which is allotted to our little individual existence. We refer and compare everything to it, in about the same way as I suppose the mayfly does to her own little life, after she has become accustomed to the fact that her existence is counted only by a few hours.

I am perfectly aware that these and many other philosophical conceptions are receiving consideration from such broad-minded scientists as have not grown up to consider science as divided in water-tight compartments. For them the borderland between the different fields of specialized science becomes the favorite hunting-ground for the philosopher. To the latter, scientific pursuits mean something broader, something higher than a mere concentration on a special field, to the exclusion of all others.

On the other hand, over-specialized science is apt to degenerate into a mere hobby, where all conceptions of true proportions and harmony are lost. The corner grocer

who knows all about the prices and qualities of sugar, coffee and tea, and little else, is nothing less than an exaggerated example of over-specialized knowledge. In the same way, I am sorry to say it, I have met many an example of so-called scientists whose science does not rank higher than what is involved in the pursuits of my boy when he is eagerly engaged in the collection of cancelled postage stamps. Knowledge does not contribute necessarily to the wisdom of the individual, unless that knowledge be sufficiently diversified to stimulate his thinking powers. The scientist who spends all his time in purely theoretical work and looks down upon the man who tries to find industrial applications for our knowledge, shows just as much unwarranted one-sidedness as the so-called 'practical' man or empiricist who expresses contempt for purely scientific pursuits.

For fear that I may be misinterpreted, let me repeat that I shall be the last to deny that every one of us is compelled to specialize more or less, in order that we may become thorough in some one branch of human activity and in order to develop our individual usefulness. I am aware that even the dullest specialist, who does conscientious work, will be of some use to the community: If he be engaged in scientific research work, and carefully records well-observed facts, he renders a service to mankind; he presents us with his own home-made little bricks, which in time, will be used by the architects of science to build up the ever-increasing edifice of knowledge.

I hope, I need scarcely add, that I further believe that well-recorded scientific facts of small immediate importance may in time become immensely valuable as compared with elegant but wrongly conceived theories based on hasty generalizations.

I believe, also, that in these times of unbalanced industrialism and greed, the law of self-preservation commands us to select a specialty as a bread-winning pursuit. I am fully aware that insufficient pecuniary resources compel many of us to curtail our preliminary studies to the very minimum consistent with what we absolutely need so as to enter into a remunerative trade or profession.

But however light-weighted our educational baggage may be, when we enter practical life, nothing but our own indifference, our bad judgment, our lack of aspiration towards nobler aims, prevents us from remedying this. Every day of our life, as long as we live, is given to us for increasing by self-culture the slender outfit with which we left school. And self-culture, in order to be effective, ought to be directed so as to counteract any one-sided tendencies resulting from our specialistic daily occupations.

The majority of individuals give by far the largest amount of their work, their endeavors, their thoughts, to the production of wealth, or to put it simpler: the art of making money. Yet, engrossed as we are in this one-sided occupation, very few of us think it worth while to undertake the study of that science which investigates the laws of production and distribution of wealth. Ignoring the true, if elementary, principles of political economy or believing in a perverted political economy which has been invented to serve the ends of a few as against the rights and interests of the many, we help to perpetuate the main cause of numerous social ailments. The scant attempt of serious attention which is given to this branch of knowledge by any but a few specialists, has rendered possible the exaggerations and irregularities of our system of industrialism. It has helped to keep in bondage many deserving men of exalted character but unable to develop their possibilities, as they

might do, under a wiser system. Who does not know of some otherwise highly developed individual who now is treated with contempt because he committed the crime unpardoned by our modern society; of failing to master that greedy art of accumulating money for himself, or for others.

Over-specialists as we are in our daily pursuits, we are ever prone to scorn the politicians; we think we have done all our duties as citizens if on election day we take time to cast our vote instead of standing all day on the golf links, but only to find out afterwards that we have supported men who, through ignorance and selfishness, hoodwink us and prevent us making our country the true democratic republic so simply and forcefully defined by Lincoln as: a govenment of the people, by the people and for the people.

If we have any fault to find with our politicians and lawmakers we should blame none but ourselves and that tendency of overspecialization which keeps us in our own narrow routine and lets the politician-specialist rule us and the country as well.

If political economics is a science of momentous interest to everybody alive, it is specially of interest to the chemist, who, thorough believer in the laws of nature, can not fail to admit the same universal yet simple laws in sociology; and who, therefore, is less apt to be misled by those juggleries of reasoning which are so cleverly used to favor private interests against the weal of the community at large. Political economy, different from most sciences, can be mastered without any preparation whatsoever, excepting the relinquishment of all bias and all petty ideas of greed, conceit or inequity.

But what shall I say about our criminal neglect of eugenics, a science which goes to the very roots of our lives; a knowledge which deals with the future of our children, the happiness and betterment of our race, and yet so neglected that its very name is scarcely known in our usual vocabulary. In the meantime, we go on in our happy-go-lucky-slip-shod way; we assume the tremendous responsibility of parentage and we jeopardize the health and happiness of our children and grandchildren by our carelessness. Instead of trying to bring together in marriage, by orderly, careful and methodic selection, such persons as are physically and mentally best fit for ennobling our race, we leave this important matter entirely to the whim of chance, blinded by emotion or prejudice. Our actions in this as in many other instances, are but the logical outcome of a thoughtless one-sided education which does not deal with these subjects, while under the name of *belles-lettres* our thoughts are still further perverted in prose and in rhyme by romantic novelists, who in their own way write on the subject of love and marriage. Neither should we be astonished, if frequently those who feel proudest or brag loudest about their ancestry make very light work of their own lives, as far as their actions involve any responsibility towards their offspring.

Our one-sidedness of conceptions has fraught our whole social system with inconsistencies: we grant the unwarranted privilege to vote to illiterate blacks and whites, tramps or idlers; but from the intelligent, virtuous and active woman who is the mother of our children we absolutely withhold the *right* to participate in the affairs of the nation.

Our lack of broad-mindedness is shown in many other ways. We admit the principle of evolution, but when it comes to concede rights and friendliness towards animals—fellowbeings—we fall short of our theories: we eagerly forget that other living creatures enjoy life and suffer, feel and think as we ourselves, if not exactly in

the same way. Some of us claim to be civilized and yet find high pleasure and recreation in hunting, killing, maiming and torturing defenseless animals, although we go on criticizing the Spaniards who enjoy the gore of a bull-fight. And even those of us who admit the savage cruelty of hunting and kindred sports do not hesitate to elevate, propagate and degenerate certain species of domestic animals with the express purpose of killing them for food. We do not see anything inconsistent in the fact that, scientific though we are, and while we talk snobbishly of our refined taste, we are much less particular than plant-eating animals, and we keep feeding on corpses of fellow creatures.

We call ourselves scientists because we believe in the laws of nature. In our studies and our research work we have never-ending opportunities for admiring the marvelous harmony of nature, the invariable laws of God. Yet when we hold our annual banquet of scientists we fail to see that we blaspheme the God of law and order and deny the immutability of his laws by asking him in prayer (and in this similar to savages) to disturb these eternal laws of nature so as to grant us some petty favors, forgetting that we are merely insignificant little dots in the immensity of the universe.

Let me conclude this essay by repeating the main points mentioned therein:

If specialization may be advantageous for increasing our productiveness in a given field of activity, over-specialization, on the other hand, may develop one-sidedness; it may stunt our growth as men and citizens; even for persons engaged in scientific pursuits it may render impossible the attainment of true and general philosophic conceptions.

If I have succeeded in convincing some of us that over-specialization does not bring forth the very best there is in us, if I have contributed ever so little to keep us aloof from the life of dizzy automatic machines, if I have succeeded even in the smallest degree in stimulating you to nobler endeavors, then I shall indeed feel very amply rewarded by your kind attention.

L. H. Baekeland

SCIENTIFIC BOOKS

The Syllogistic Philosophy or Prolegomena to Science. By Francis Ellingwood Abbot, Ph.D. Boston: Little, Brown & Co. 1906. 2 vols. Pp. xiv + 317; vi + 376.

These volumes are the philosophical testament of their author (d. 1903), whose previous works—'Scientific Theism' (1883), 'The Way out of Agnosticism' (1890), and contributions to 'The Index' (1870–80), of which he was editor—constitute preliminary surveys. The work has been in preparation more or less since 1859 (*cf.* ii., 291), and was reduced to its present form in the decade 1893–1903. In his pathetic preface and valedictory words, Dr. Abbot states his purpose and expectations with no uncertain sound. He puts in a claim to have superseded all previous thinkers, to be enrolled with the greatest classics. In so doing, he remembered, doubtless, that he was also courting the stringent criticism which men accord to the classics only.

> If at last it shall receive sober, just and intelligent appreciation, I believe it will be found to have done for philosophy what was done for botany in transition from the artificial Linnæan classification to the natural system of classification by total organic and genetic relationship—a revolution never to be reversed; and to give to ethical and free religion what it has never yet had, a basis in scientific reason (I., xi). My work of forty-four years is done, and I commit its destinies to the Master of Life, whom I have resolutely but reverently sought to know by using the free reason which is his supreme gift to man (II., 296).

In the circumstances, and face to face with Dr. Abbot's *ex cathedra* earnestness, criticism becomes an ungrateful task. One can only say, to begin with, that whether these tremendous expectations are to be justified time alone can tell. But after a careful and sympathetic perusal of the contents, I feel com-

pelled, meantime, to reply in a decided negative. I can not find that Lucretius's address to Epicurus applies:

O tenebris tantis tam clarum extollere lumen
Qui primus potuisti, illustrans commoda vitæ;

and nothing short of this would befit the plea set forth. Well equipped with wide and careful reading as Dr. Abbot evidently was, he seems to have fallen upon an arid formalism which forces him to serve up afresh, and with reiterated emphasis, many of the contingent features peculiar to idealistic absolutism in the nineteenth century. In short his scholasticism is such that he is unfitted by sheer mental constitution for the leadership of that new and transitive school for which he longed. Indeed, it is plain, and to be deplored possibly, that his 'Syllogistic Philosophy' must remain a sealed book to all except a few curious specialists. And, even for this select company, its interest, I apprehend, is already largely historical. For it furnishes what might be termed a species of epilogue to transcendentalism as understood in America. I should judge it typical of certain tendencies of New England unitarianism, rather than symptomatic of the fresh philosophical synthesis which, as many admit, may emerge during the present generation. True, propinquity may have made me myopic; but I can not see the conclusion otherwise. For, despite Dr. Abbot's blindness to his historical position and obligations—a blindness which, paradoxically, lends his work its chief interest—he is little more than another of the many derivants from Hegel, but, as so often, from Hegel with his concrete thinking omitted.

The crux of Dr. Abbot's position resides in his criticism of Hegel. Here he has failed to appreciate the Hegelian distinction between *Verstandes-Allgemeinheit* and *Allgemeinheit des Begriffes*. He would reduce Hegel to the level of a mere continuator of Aristotle, nay, of Aristotle taken at his worst. It is surely a piece of extraordinary perversity to find Hegel's characteristic doctrine of universals in the Nürnberg *Propädeutik* (*cf.* i., 265 f.), even if one may forgive the oversight whereby, at this late date, a writer omits to notice that Aristotle's metaphysical teaching implies a principle by which the 'Paradox' of his logic can be overpassed. And it is still more astonishing to discover that the criticism of Hegel proceeds from a standpoint already made abundantly plain by Hegel himself. No doubt, the Hegelian exploitation of the evolution of the categories may be regarded now as insufficient, or even inapplicable, thanks to those very historical investigations which originated in the impetus exerted by the Hegelian system. But, then, Dr. Abbot offers no concrete *Darstellung* of his own categories. No doubt, evolution is a problem to-day as it could never be to Hegel. But, then, the mere statement that Darwin, by his discovery of 'advantageous variations,' set this new problem, by no means solves it *philosophically*. If the problem is to be attacked from the logical side, a reconsideration of the entire office and operation of disjunction becomes inevitable, and of this Dr. Abbot betrays no consciousness. From first to last he remains curiously impatient of doubt as a test of his own position—he is too sure of it for this, and so he fails to reap the results which follow only from the 'labor of the notion.' The one possible conclusion is that he was so much of an intellectual recluse, even an ascetic, as to injure his perspective.

What quarrel with Hegel has the man who can write as follows? And what obligation does he not owe him? "The only possible modes, functions, or faculties of knowledge are, from the sheer necessity of the case, in the uncreated 'nature of things,' those two forms of activity of the one knowing-faculty which, on the side of the unit, we call sensibility, or perception, or experience, and, on the side of the universal, understanding or conception or reason" (i., 207). Obviously, Dr. Abbot belongs with the monistic idealists; but is so obsessed of abiding a priest continually that he confesses to being without father, without mother, without descent. One does not accuse him of mere apprenticeship to the Berlin master. But, in spirit, general outlook, and necessary consequence, where do we find, if not in Hegel, the kinship of the following, which is Dr. Abbot's conclusion of

the whole matter? Not in the Nürnberg *Propädeutik*, truly, nor yet in *reines Denken* as a purely 'subjective' function; but Hegel had some other things to say! "It becomes very clear that one and the same method obtains" in each of the three spheres of being, knowing and doing, "the method of absolute syllogistic. Genera, species and specimens are the only realities in being; genera are realized only in the whole of their species, and species only in the whole of their specimens; the relation of genus, species, and specimen is necessarily that of the three terms in the syllogism. * * * Similarly, ideas, concepts and percepts are the only realities in knowing; ideas are realized only in concepts, and concepts only in percepts; the relation of idea, concept and percept is that of the three terms of the syllogism. * * * Lastly, ideals, purposes and deeds are the only realities in doing; ideals are realized only in purposes, and purposes only in deeds; the relation of ideal, purpose and deed is that of the three terms of the syllogism. * * * Through this principle of absolute syllogistic as the law of unit-universals, or apriori of being, or necessary identity of methods in the sphere of reality and ideality alike, philosophy attains its end in syllogistic as the principle of absolute methodology, and in personality as the topmost reach of its application in human knowledge" (ii., 285 f.). By how much does this differ from, say, the *Rechtsphilosophie*? And by how much the *Rechtsphilosophie* differs from this, because based on an analysis far more profound than that offered in 'Syllogistic'!

For the rest, suffice it to say that students of technical philosophy will find some suggestive criticisms in these pages; for, notwithstanding its author's avowed purpose, the work ranks much stronger in destructive than in constructive material, a circumstance in itself indicative of much. Second, a number of acute interpretations, particularly of Aristotle, Kant and Fichte, are presented, which will raise controversy, and possess the merit of sending the reader to the original sources. Third, Darwin is hailed, not simply as a great scientific man, but as the herald of a new philosophy which, in all likelihood, he would have failed to comprehend. Lastly, much is offered which could be worked up into an epistemology or logic with advantage, were it first subjected to fundamental analyses. For example, we read:

> Every logical conclusion from true premises, that is, every concreted syllogism of knowledge, every true judgment, or real cognition, is one of the ultimate cells which syllogistic, as the cell-theory of the organism of universal human knowledge, recognizes as the indivisible living components of all science and all philosophy. The object, we repeat, determines the subject in knowing. That is, what the object is in itself, even on the idealist's assumption that the subject has created it, must determine all possible knowledge of it; the relations immanent in it must determine all relations immanent in the cognition of it, since any variation in these at once vitiates the cognition so far (II., 247 f.).

Elements are presented here which idealism has not been too prone to emphasize; but they stand in sore need of the regress of criticism.

Dr. Abbot's intense seriousness and total lack of humor, added to his exasperating repetition of formulæ such as the mystic 'My self as one of the we,' and the 'I in the we,' render the work difficult reading; but as a mental gymnastic, the effort to discover the author's special originality and to justify his treatment of the classics of the past, may be recommended. An admirable index makes reference easy.

R. M. Wenley
University of Michigan

American Fossil Cycads. G. R. Wieland. The Carnegie Institution of Washington, 1906. Pp. viii + 296. Pl. I.–L.

The appearance of this handsome quarto volume marks a very important forward step in our knowledge of the Cycadales, while it also throws a great deal of light upon the general problem of the phylogeny of the gymnosperms and their supposed relation to filicinean ancestors. It is the result of studies carried out by Dr. Wieland since 1898, when the first field work was undertaken. In the present treatment the author devotes his attention to establishing the obvious boundaries and botanical aspects of the cycads, reserving their

classification and nomenclature for future consideration; nor does he fail to indicate what must be of the greatest interest to those who are concerned in the solution of broad biological problems, that a study of the seed is certain to reveal much of the highest importance, and we are led to believe that on a future occasion the author may take up this part of the subject more in detail.

The first cycadean trunks from America to receive scientific mention were obtained from the Potomac formation of Maryland and were noticed by Philip Tyson in 1860; but for more than a quarter of a century they remained practically unnoticed until, in 1889, some of the original Tyson specimens which had come into possession of the Maryland Academy of Natural Science were described and illustrated in accordance with their macroscopic characters by Fontaine.

A further collection of Maryland cycads was made in 1893 by Mr. Arthur Bibbins, and this valuable material is now in the museum of the Woman's College, Baltimore. Most of it was gathered from various country people between Baltimore and Washington, representing in all some sixty specimens which had 'been unsuspectedly sequestered from time to time during the preceding hundred years.' Much loss to science resulted during that period, owing to the fact that, being regarded with idle curiosity or with more or less superstitious interest, the specimens had been carelessly treated, while many of those which were too large to handle with ease were broken up and many valuable parts were lost. Characteristic methods of branching were thereby wholly destroyed. As later determined by Professor Ward, this collection was found to embrace seven species of *Cycadeoidea.*

At various times trunks of cycads have been obtained from other widely separated localities, such as the Trias of Prince Edward Island, the Dakota formation of southern Kansas, from one or two localities in Colorado and from California, but the richest deposit of these remains is to be found in the Mesozoic rim of the Black Hills of South Dakota and Wyoming.

Scientific attention was not directed to this locality until 1893, although on several previous occasions miners proceeding to Deadwood had observed them at Black Hawk and Minnekahta; but at that time six silicified trunks were received at the United States National Museum, and five years later they were described by Ward, who found them to include four species of *Cycadeoidea.* This collection, together with another lot of twenty trunks obtained by Professor T. H. MacBride later in the same summer, served to arouse great interest and to awaken the special enthusiasm of Professor O. C. Marsh, of Yale University, whose efforts to secure a representative collection resulted in placing more than seven hundred trunks, many of them of large size and fine preservation, in the Yale Museum. This truly magnificent series furnishes the greater part of the material upon which the present monograph is based.

In the Freezeout Hills of Carbon County, Wyoming, there is another cycad locality which ranks as third in importance on this continent. The discovery of this locality is due to Professor Marsh, who obtained a very large collection of specimens representing exclusively the genus *Cycadella.*

An examination of the American distribution of the cycads shows them to be represented in the following geological horizons:

		Species
1. Trias of Prince Edward Island	*Cycadeoidea,*	1
2. Trias of York, Pa.	*Cycadeomyelon,*	1
3. Upper Trias of North Carolina	*Cycadeoidea,*	1
4. Jurassic of Colorado	*Cycadeoidea,*	1
5. Upper Jurassic, Wealden or Cretaceous of the Black Hills of South Dakota and Wyoming	*Cycadeoidea,*	27
6. Upper Jurassic of Central Wyoming and Black Hills, and from Freezeout Hills, Wyoming	*Cycadella,*	21
7. Potomac Formation of Maryland	*Cycadeoidea,*	7
8. Lower Chico of Colusa County, Cal.		1

9. Dakota Formation of Kansas	*Cycadeoidea,*	1
10. Pre-Laramie (?) of Golden, Colo.	*Cycadeoidea,*	1

From this it may be observed that up to the present it is possible to recognize

	Species.
Cycadeomyelon	1
Cycadella	21
Cycadeoidea	40

with one specimen as yet unidentified.

The author discusses at some length the varying conditions of fossilization and the resulting effect upon structure; and he further directs attention to the alterations of external form due to pressure, either during or after fossilization. The cutting of such bulky material, and more particularly the excision of special parts, required the elaboration of special methods and the manufacture of specially constructed cutting tools; but the exercise of ingenuity, skill and great patience enabled the author to cut all his own sections with great success.

As in existing cycads, the fossil forms show a highly developed armor composed primarily of the persistent leaf bases; but in addition there is a ramentum which is borne over and densely packed between the leaf, peduncle and bract surfaces, as well as thickly enveloping the entire crown. The presence of such a ramentum is well known, not only in the cycads, but also in the ferns. The special features of this structure in the present case are, first, the perfection of its preservation, probably resulting from the free percolation of silica-laden solutions through the hairy ramental mass; and second, the fact that among fossil species the ramentum shows a profuse development which is in striking contrast with its very reduced condition in existing species, and which in *Cycadella* results in fully half the bulk of the trunk being made up of this material. This variation, while at first appearing to constitute the basis of a broad differentiation of the great groups, is in reality little more than of generic importance. The various stages of development found show conclusively that the Cycadeoideæ and Cycadaceæ have been alike subject to a progressive reduction of the profuse ramentum characterizing their common Paleozoic filicinean ancestry.

The most striking external feature of all the cycads is to be found in the armor composed of spirally arranged old leaf bases. In existing cycads the regular order in which the leaves appear is not disturbed except by the appearance of terminal cones. In Cycadeoideæ, on the other hand, disturbance of this arrangement is very common and is due to the emergence of numerous large and laterally borne fructifications, and to the particular level at which periderm formation takes place. In consequence of these disturbances, the leaf arrangement can not be used for either generic or specific distinctions. A much more definite and constant feature is to be found in the particular grouping of the vascular bundles in the leaf scars.

Special interest centers in the character of the inflorescence. A study of the ovulate cone of *Cycadeoidea wielandi* shows a structure which arises from between the old leaf bases or else from their axils in part, at any point between the base of the trunk and the youngest series of leaves. In structure they present the type exhibited by *Bennettites gibsonianus* and *B. morierei.* But it is found that in all the strobili, situated about the lateral bract-bearing surface of the peduncle, and just beneath the terminal ovulate cone, there is an annular shoulder which bears distinct traces of some earlier, dehiscent or abortive or wilted disk. This disk is seated on the receptacle above the bracts, and vascular bundles pass out to it from the woody cylinder of the peduncle. This disk is interpreted as a staminate receptacle, and its presence in all the specimens from the Black Hills is held to signify that all these species were bisporangiate. In some cases the inconspicuous character of the disk leads to the inference that the inflorescence was homosporous. The evidence presented by the great majority of cones studied supports the conclusion that all the known Cycadeoideæ are descended from bisporangiate forms, and that of all the considerable number of fruits

of *Cycadeoidea* and *Bennettites gibsonianus*, or allied species, far the larger portion were actually bisporangiate and discophorous. That this conclusion has not resulted from previous studies, and that it has only rarely been suggested in a modified form, is ascribed to the imperfection of the longitudinal sections of cones.

The orthotropous seeds are about the size of a small grain of rye, and each is produced on a separate pedicel. Only one coat encloses the nucellus. In this respect *Cycadeoidea wielandi* is comparable with *Bennettites morierei* from which, however, it differs in detail to such an extent that the two can not be homologized with certainty. The seed coat of the former is nevertheless exactly comparable with *Lagenostoma*, which, of all the existing and extinct forms thus far discussed, affords the most striking structural parallels with American *Cycadeoidea* seeds.

A further parallelism between the American *Cycadeoidea dacotense* and *C. wielandi*, and the European *Bennettites gibsonianus* and *B. morierei*, is to be found in the presence of well-marked dicotyledonous embryos which more or less nearly fill the entire space and indicate a nearly, if not complete, exalbuminous condition. These embryos are strikingly like those of *Gingko*. Evidence has also been obtained with respect to the existence of an earlier or preembryonic stage which has never been found preserved in any other specimen or hitherto observed in any other fossil gymnosperm or other plant. The evidence points to the replacement of the oospore by a homogeneous tissue and the absence of a suspensor. The embryo was therefore formed directly through growth of the oospore which thus represents the proembryo or protocorm. The suggestion arising from these facts is an analogy with *Ginkgo* in which there is a much more simple form of embryogeny than in other gymnosperms.

One of the most striking facts revealed by the studies so far completed, is that the hiatus between the two great Cycadean lines is of a two-fold character. In existing cycads great complication of the cortical bundle system has developed, while the reproductive organs are relatively little changed and primitive. Conversely, in the Cycadeoideæ there is a retention of the primitive cortical system together with the most surprising reproductive changes leading up to the bisexual flower which mimics that of the angiosperms. It is therefore natural to ask if two groups so related shall be included in one greater class, the Cycadales, or the Cycadeoideæ be excluded from the true Cycadales, as Bennettitales or Cycadeoidales? After a careful review of the positions taken by Scott, Zeiller, Potonié and Count Solms, and of the evidence afforded by the paleontological record, it is held that the Cycadeoideæ find their appropriate place amongst the true Cycadales.

An interesting summary of the fern-cycad relations, together with suggestions bearing upon analogies of the ferns and angiosperms, closes a very able treatment of a difficult but intensely fascinating problem. The general tendency of the evidence is to greatly strengthen the current views respecting the marattiaceous origin of the cycads; or, in the pregnant words of the author "The preceding résumé of the principal characters of the two great cycad groups as combined and showing their descent from marattiaceous ferns of the Paleozoic, is not merely conclusive, but one of the great cornerstones upon which the conception of evolution can rest secure."

D. P. Penhallow

Montreal,
May, 1907

SCIENTIFIC JOURNALS AND ARTICLES

The April number (volume 8, number 2) of the *Transactions of the American Mathematical Society* contains the following papers:

E. Kasner: 'Dynamical trajectories: the motion of a particle in an arbitrary field of force.'

W. R. Longley: 'A class of periodic orbits of an infinitesimal body subject to the attraction of n finite bodies.'

E. B. Van Vleck: 'A proof of some theorems on pointwise discontinuous functions.'

L. E. Dickson: 'Invariants of binary forms under modular transformations.'

E. J. Wilczynski: 'Projective differential geometry of curved surfaces (First memoir).'

J. I. Hutchinson: 'A method for constructing

the fundamental region of a discontinuous group of linear transformations.'

E. B. Wilson: 'Oblique reflections and unimodular strains.'

C. N. Moore: 'On the introduction of convergence factors into summable series and summable integrals.'

The May number (volume 13, number 8) of the *Bulletin of the American Mathematical Society* contains: Report of the February meeting of the San Francisco Section, by W. A. Manning; Report of the Fifty-seventh Meeting of the American Association for the Advancement of Science, by L. G. Weld; 'On a Final Form of the Theorem of Uniform Continuity,' by E. R. Hedrick; 'The Groups Generated by Three Operators Each of which is the Product of the Other Two,' by G. A. Miller; 'A Table of Multiply Perfect Numbers,' by R. D. Carmichael; 'The Symmetric Group on Eight Letters and the Senary First Hypoabelian Group,' by L. E. Dickson; 'Double Points of Unicursal Curves,' by J. E. Wright; 'The Mathematical Tablets of Nippur,' by D. E. Smith; 'Osgood's Theory of Functions' (Notice of Professor W. F. Osgood's Lehrbuch der Funktionentheorie), by H. S. White; Shorter Notices (Arnoux's Introduction a l'Etude des Fonctions Arithmétiques, by W. H. Bussey; Neumann's Studien über die Methoden von C. Neumann und G. Robin zur Lösung der beiden Randwertaufgaben der Potentialtheorie, by O. D. Kellogg; Biermann's Vorlesungen über mathematische Näherungsmethoden, by J. W. Young; Ariès's La Statique Chimique Basée sur les deux Principes Fondamentaux de la Thermodynamique, by E. B. Wilson); Notes; New Publications.

SOCIETIES AND ACADEMIES

THE IOWA ACADEMY OF SCIENCES

The twenty-first annual session of the Iowa Academy of Science was held at Drake University, Des Moines, Iowa, on April 26 and 27. The meeting was well attended and much interest was manifested in the papers presented. In addition to the regular program, illustrated lectures were given on the evening of the twenty-sixth by Professor H. L. Russell, of the University of Wisconsin, on 'Recent Discoveries with Reference to Insect-borne Diseases,' and by Professor W. W. Campbell, director of the Lick Observatory, on 'The Solar Eclipse in Spain.'

The officers elected for the ensuing year are:

President—John L. Tilton, Simpson College.

First Vice-President—C. L. Von Ende, State University.

Second Vice-President—Nicholas Knight, Cornell College.

Secretary—L. S. Ross, Drake University.

Treasurer—H. E. Summers, Iowa State College.

The following program was presented:

The Influence of Science in Forming Ideals. President's Address: C. O. Bates.

Exposures of Iowan and Kansan (?) Drift, East of the Usually Accepted Boundary Line of the Driftless Area: Ellison Orr.

(*a*) *Volcanic Phenomena around Citlaltepetl and Popocatepetl, Mexico;* (*b*) *Physiographic significance of the Mesa de Maya;* (*c*) *Tertiary Terranes of New Mexico:* Charles R. Keyes.

A Visit to the Panama Canal (illustrated): Grant E. Finch.

An account of three weeks of observations on the Canal Zone during the summer of 1906. Impressions of climatic conditions and of problems and progress in the canal enterprise.

(*a*) *The Channel of the Mississippi between Lansing and Dubuque* (illustrated); (*b*) *The Unconformity at the Base of the Saint Louis Limestone* (illustrated): S. Calvin.

(*a*) *Recent Alluvial Changes in Southwest Iowa;* (*b*) *Effect of Certain Characteristics of Formations upon Rate of Their Erosion:* J. E. Todd.

(*a*) *The Loess of the Missouri River* (illustrated).

In large part a rejoinder to Professor Todd's late paper on the same subject, especial attention being given to his attempted explanation of the manner in which the shells of molluscs found their way into the deposit.

(*b*) *The Loess of the Paha* (illustrated).

The formation of loess on the Paha by wind is explained largely on the basis of plant ecology.

(*c*) *The Loess and the Nebraska Man* (illustrated): B. SHIMEK.

A brief discussion of the weakness of the evidence that the human remains found near Florence, Nebr., are in undisturbed loess.

The Orbit of the Asteroid, 1906 W. E.: E. B. STOUFFER.

A Catalogue of the Poisonous Plants of Iowa: L. H. PAMMEL and ESTELLE D. FOGEL.

The purpose of the catalogue is to enumerate the plants that are poisonous to live stock.

A Study of the Variation in the Number of Ray Flowers in Certain Compositæ: W. S. DUDGEON. (Presented by L. H. Pammel.)

A study was made of the ray flowers of the following plants: *Rudbeckia triloba, R. hirta* and *Helianthus grosseserratus.* The constant was worked out according to Professor Davenport's formula. The ray flowers of *R. hirta* vary from 2 to 28 out of 3,847 counted; 1,327 had 13 rays. The ray flowers of *R. triloba* vary from 5 to 18. The ray flowers of the sunflower vary from 7 to 25. In *R. hirta* there appear to be two well-marked forms.

Iowa Erysiphaceæ: J. P. ANDERSON.

Notes on Iowa Algæ: R. E. BUCHANAN.

Keys to groups and species of algæ and their reported distribution in the state.

The Homologies of Tissues in Ferns: H. S. CONARD.

Studies in Karyokinesis: J. E. GOW.

An account is here presented of some observations on the process of cell division in the pollen mother cells of *Trillium sessile,* in the vegetative cells of the nucellus of *Arisæma,* and in the young root tips of *Zea mays.* Attention is called to the latter as contradicting, apparently, certain accepted theories of vegetative cell divisions.

(*a*) *The Estimation of Silica;* (*b*) *The Analysis of Some Iowa Waters:* NICHOLAS KNIGHT.

The Recent Investigation of Iowa Ground Waters: W. S. HENDRICKSON.

Some Problems in Municipal Sanitation: L. H. PAMMEL.

The question of the water supply for cities and villages is a very important one. With the density of population increasing, the problem becomes more complex. All of our Iowa streams are more or less polluted. The paper discusses some of these and the supposed case of pollution when a railroad passes over water. Such pollution will not occur if proper precautions are taken.

The Physical Science Laboratory of the State Normal School (illustrated): A. C. PAGE.

Description of new laboratory presented because of possible interest to any contemplating building.

The Lateral Line System of Amphiuma: H. W. NORRIS.

Securing a Stand of Clover on the Southern Iowa Loess—A Biological Study: E. B. WATSON.

L. S. ROSS,
Secretary

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE seventh special meeting was held at Washington, May 7 and 9, in conjunction with the Congress of American Physicians and Surgeons.

The sessions of the society were held in the Physiological Laboratory of the George Washington University.

The scientific program was as follows:

TUESDAY, MAY 7

YANDELL HENDERSON: 'Production of Shock by Loss of Carbon Dioxide and Relief by Partial Asphyxiation.'

J. A. E. EYSTER: 'Vagus Inhibition from Rise of Pressure in the Aorta.'

DONALD R. HOOKER: 'May Reflex Cardiac Acceleration occur Independently of the Cardio-inhibitory Center?'

WILLIAM H. HOWELL: 'The Calcium and Potassium Metabolism of the Heart during Inhibition and Acceleration or Augmentation.'

T. SOLLMANN: 'The Acute Effects of Gastric and Peritoneal Cauterization and Irritation on the Blood Pressure and Respiration.'

T. SOLLMANN: 'Perfusion Experiments on Excised Kidneys: Solutions of Electrolytes.'

VELYIEN E. HENDERSON: 'The Teaching of

Physiology in the Laboratory.' (A discussion of this paper is especially invited.)

C. C. Guthrie: 'Results of Removal and Transplantation of Ovaries in Chickens.'

R. S. Lillie: 'The Influence of Electrolytes on the Osmotic Pressure of Colloidal Solutions.'

THURSDAY, MAY 9

Joint session with the American Society of Biological Chemists.

Reid Hunt: 'Notes on the Thyroid.'

Walter Jones: 'On the Occurrence of Ferments in Embryos.'

C. G. L. Wolf and Philip A. Shaffer: 'Metabolism in Cystinuria.'

C. G. L. Wolf: 'Protein Metabolism in the Dog.'

A. B. Macallum and C. C. Benson: 'The Composition and Character of the Hourly Excretions of Urine.'

S. P. Beebe: 'The Parathyroid Gland.'

V. C. Vaughan: 'Proteid Susceptibility and Immunity.'

Waldemar Koch: 'The Distribution of Sulphur and Phosphorus in the Human Brain.'

A. D. Emmett and William J. Gies: 'On the Composition of Collagen and the Chemical Relation of Collagen to Gelatin.'

Lafayette B. Mendel: 'Embryo-chemical Studies.'

Joint session with the Association of American Physicians.

Symposium upon acidosis. The discussion was introduced by Dr. E. P. Joslin, representing the Association of American Physicians, and Dr. Otto Folin, representing the American Physiological Society; and followed by a discussion, in which Dr. Graham Lusk, Dr. Lafayette B. Mendel, Dr. A. E. Taylor, Dr. L. F. Barker, Dr. W. S. Thayer and others took part.

The following resolutions were adopted by the society, in association with the American Society of Biological Chemists at the joint session: "This society approves of the movement represented by the Committee of One Hundred of the American Association for the Advancement of Science to increase and coordinate the present activities of the federal government in matters pertaining to public health. This society therefore urges upon the President of the United States and members of Congress the favorable consideration of such legislative measures as are best adapted to secure this result."

The society decided to hold the next annual meeting in Chicago during Convocation week, December, 1907.

Lafayette B. Mendel,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 429th meeting was held April 6, 1907, with President Stejneger in the chair.

Under short notes Dr. Hopkins called attention to the influence of the recent abnormal warm weather on the opening of the buds of certain forest trees, stating that certain early varieties of American linden trees on B Street, southwest, were fourteen days earlier this spring than last, but that the buds on the late varieties of the same species were not influenced, thus indicating a method of locating varieties of forest trees and the determination of the range of a given periodical phenomenon within a species as influenced by normal and abnormal seasonal conditions. Phenological data collected during the past ten years show quite conclusively that the average time of the beginning of seasonal activity of certain species and varieties of indigenous plants and animals, that remain dormant during the winter, may be utilized as an index or guide to the dates each season when, at different latitudes and altitudes, the conditions are most favorable for action against certain insect pests, plant diseases, etc. The same records show that there is a normal variation in a given phenological phenomenon of about four days for a difference of four hundred feet of altitude and four days for a difference of one degree of latitude, thus it has been shown that within a state like West Virginia there may be a variation of thirty days on the same degree of latitude, due to a difference of 3,000 feet altitude, which is equivalent to a difference of about seven degrees of latitude at the same altitude. Thus, the normal variation between two localities may be calculated approximately, but the response of life activity in certain index forms of plants and animals, to general and local climatic and other influences, will not only give quite positive evidence of the actual variation between localities, but will

serve as most reliable guides to the solving of certain economic problems, as, for instance, the control of certain insect enemies of forests which require remedial action within a short period in their seasonal history.

The practical application of the principle outlined in these remarks has been referred to by Dr. Hopkins in Bulletin 50, West Virginia Agricultural Experiment Station, 1898, pp. 17–18, Bulletin 67; ibid., 1900, pp. 241–248; and Bulletin No. 58, Part III., Bureau of Entomology, U. S. Department of Agriculture, 1907, p. 32.

Dr. Gill, apropos of his recent Smithsonian article on 'Parental Care among Freshwater Fishes' and the numerous cases of oral gestation and harboring the young in the mouth, called attention to an article in a Swiss journal (*Bibliothèque universelle*, Geneva, 1905) by Dr. Fuhrmann, announcing that an osteoglossoid fish of Borneo (*Scleropages formosus*) also took the young into the mouth after hatching; the data given, however, were scanty and it was not stated whether the egg-carrier was the female or male.

The regular program consisted of an address by Dr. George A. Soper, of New York, on 'A Chronic Typhoid Fever Producer,' and discussion following.

The speaker, after introduction by Dr. L. O. Howard, gave a detailed account of his investigation covering several months into the source of a household epidemic of typhoid fever occurring in Oyster Bay, N. Y., during the summer of 1906. Of eleven persons six developed positive cases of typhoid between August 27 and September 3. Several suspected sources—water, milk, vegetables, fruit and soft clams—were excluded by careful study and examination. Repeated sanitary analysis of the water supply and failure to detect subsoil pollution by fluorescein tests of the drainage showed the infection was not water borne. Typhoid was unusual in Oyster Bay and there were no cases immediately preceding or following those under consideration. The milk and food supply of the infected household was common to others of the village without the occurrence of other cases. None of the patients had been absent for several weeks prior to the outbreak and they therefore had acquired it on the premises. The house and surroundings were in an entirely hygienic condition. The investigator inferred the occurrence of some unusual event prior to August 20, and found it in a change of cooks August 4. The new cook's term of service with this family covered a period three weeks prior to and three weeks subsequent to the outbreak. She refused to give any information tending to connect her with the cases, but an independent investigation of her previous service disclosed a startling and significant history of typhoid. Despite the fact that her record for nearly two of the past five years is yet unknown, twenty-six cases of typhoid fever, including one death, were associated with her service in seven families during this time. The cases were almost entirely among the servants and the initial case frequently occurred soon after the arrival of the cook. She did not directly admit having herself suffered from typhoid, but to three persons she is said to have previously testified to a mild attack.

The evidence indicating the cook to be a competent cause of typhoid, she was taken into custody by the New York City Department of Health, March 11, 1907, and at the detention hospital a bacteriological examination was made. She was a large healthy Irishwoman, single, forty years of age. The urine was free of typhoid bacilli, but the stools showed great numbers nearly every day for the several weeks of observation. The blood gave a positive Widal reaction. Thus a healthy and vigorous subject was shown to be a chronic typhoid-fever producer. As the typhoid organism is known to persist for years in the gall bladder, this is the presumed source of the infection, removal of which requires the consent of the subject.

The speaker called attention to recent papers by Dr. Robert Koch and others on the important investigations in western Germany of typhoid outbreaks by the aid of portable or 'flying' laboratories. To the Germans the dangers of bacillus-carriers were well known. Stress was laid on the importance of contact in transmission and on the analogy in this

respect between typhoid and diphtheria and tuberculosis. A careful campaign is necessary to discover bacilli-carriers once they escape the physician's care. The rigorous measures of isolation and disinfection adopted in Germany are perhaps impracticable here at the present time, except during epidemics.

In the discussion which followed, Dr. W. C. Woodward, health officer of the District of Columbia, commended the accuracy and the scientific spirit of Dr. Soper's work and spoke of the desirability and the difficulty of procuring such accuracy in the routine work of a health department and in obtaining for such routine work men imbued with the same scientific interest as that displayed by Dr. Soper. The extreme difficulty of detecting bacillus carriers and of enforcing upon them proper isolation would constitute a serious obstacle in the way of preventing the spread of disease through them. The public should guard, however, against forming exaggerated ideas of the danger from this source. Among the many hundreds of patients suffering from typhoid fever who have come to the knowledge of the Health Department during recent years, many were housewives and other persons who, upon convalescence, necessarily took an active part in the ordinary affairs of the household. And although many of such cases must have been what are now termed bacillus carriers for longer or shorter periods after convalescence, the Health Department had yet to find a case in which there was an outbreak of typhoid fever, or even a second case, in the household after the convalescence of the first case.

Dr. Woodward asked why it was that in the families in which the bacillus carrier which formed the subject of Dr. Soper's investigation, had been employed, the number of the members of the families affected by the disease was apparently relatively so small as compared with the number of persons affected among the persons employed about the household and about the premises.

Dr. M. J. Rosenau said that the typhoid problem is now magnified and the difficulty of dealing with it increased. Though complex and intricate, the situation is not hopeless. It is not necessary to imprison the bacillus carrier; it is sufficient to restrict the activities of such an individual. As for typhoid in Washington, if largely transmitted by bacillus carriers and contacts a different epidemiological picture might be expected; the disease should increase progressively, whereas it is epidemic in the summer, declining rapidly in the fall; there is little typhoid fever here in the winter and spring. Dr. Rosenau believes that when large quantities of virulent cultures are ingested the disease is frequently induced within the usual period of incubation. Ordinarily, however, persons become infected with dilute cultures or attenuated bacteria which remain in the intestinal tract awaiting lowered resistance before the disease manifests itself. This lowered resistance is largely brought about by the enervating effects of the hot weather. This explains the seasonal prevalence of typhoid fever and why it is a summer disease in Washington and many other places.

Dr. L. O. Howard, while appreciating that a charge of professional bias might lie, felt it necessary to emphasize the rôle of the housefly as a carrier. Whether its importance is secondary, tertiary, or further removed in degree, it is certainly known to transmit typhoid even under city conditions. The housefly is abundant in low quarters and near waste lots in cities like Washington. To do away with it is a simple matter. It is but necessary to oblige stable keepers to dispose of horse manure, since 99 per cent. of the houseflies in cities are bred in it. Dr. Soper's paper has emphasized the importance of this measure by showing the possibilities of healthy human subjects as carriers. Such persons of unclean habits increase the opportunities of the housefly as a transmitter of infection.

Dr. C. W. Stiles, referring to the question why bacillus carriers did not infect more widely, drew an analogy from parasitic worms. *Oxyuris* (*Oxyurias*) *vermicularis* is transmitted by the hands. As with typhoid distributors it might be expected to infect a large number of persons. This is not the case. For instance, in an orphan asylum of several hundred, perhaps only eight or ten may be infected, though the worm is transmissible

from hand to mouth. The dwarf tape worm, *Hymenolepis nana*, is another case in point. Personal cleanliness has an important bearing.

Mr. K. F. Kellerman said that Doctor Soper's typhoid investigations have shown weighty reasons for the sterilization of sewage. Chemical sterilization is practicable at low cost, by nascent chlorine or one of the heavy metals, and should be resorted to when sewage is discharged into streams which in a short time are used as the sources of drinking water. He seconded Doctor Howard with respect to the importance of flies. At Panama typhoid is rare, and the few cases are confined to the lowest classes of negro laborers who eat in the open where flies are abundant instead of in screened dining-rooms such as are used by the Americans.

Dr. J. Goldberger gave some figures on the frequency of bacillus carriers. One thousand seven hundred cases examined at three of the laboratory stations in Germany showed 3 per cent. to be chronic carriers. It is possible to calculate the number of carriers for a given district and the probable danger to non-immunes.

Dr. G. Lloyd Magruder recalled the early typhoid investigations in Washington and the surrounding country which cited the water supply, cesspools, manure piles and milk as carriers. The city wells and water supply of many dairy farms were found contaminated. It is difficult to enforce sanitary precautions in the city and almost impossible in the country. The farm is an important source of city typhoid and the fly an important carrier on the farm.

Dr. Soper in closing replied to questions and amplified certain points. With respect to the cost of his investigation he preferred to give no figures. It had cost him personally more than he had agreed to charge at its beginning. The investigation would hardly have been undertaken in this particular instance, save for its scientific interest. His typhoid work was generally done for cities, as at Ithaca and Watertown. As to why more persons other than the servants were not attacked in the families served by the cook, he believed the members of the family were protected in large measure by the sterilizing effect of cooking, the food being chiefly handled after cooking by butlers and waitresses or servants other than the cook. The cook never handled fruit, salads and other things eaten raw by the family. Servants newly attached to the household were more apt to take the disease than those long associated with the cook. Possibly an acquired immunity explains this. Hand infection is important and the hands should receive more attention than they do. It would be well if cooks could be selected only after careful assurance concerning their histories and personal habits. In general, scrupulous cleanliness is an important safeguard against typhoid. Increase in knowledge of bacillus carriers should be looked upon as encouraging rather than otherwise, since it is only by a knowledge of the facts that preventive measures can be accurately applied and transmission can be prevented. As to the situation at Washington, the speaker preferred to say nothing until the official report of the exhaustive investigations of the Public Health Service had been made public.

At the conclusion of the meeting the chair tendered the society's thanks to the speaker for his address.

M. C. MARSH,
Recording Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 190th meeting of the society, held at the Cosmos Club, on Wednesday evening, March 27, 1907, under informal communications, Mr. F. E. Wright showed a new double screw micrometer ocular by the use of which the optic axial angle of a bi-axial mineral can be determined on any section showing in convergent polarized light an optic axis within the field of vision.

The regular program consisted of an exhibition of the geologic relief map of the Southern Appalachian Province prepared for the Jamestown Exposition. The following description of the territory covered by the map was given:

The Appalachian Mountains and Valleys: Mr. ARTHUR KEITH.

The four main geographic divisions of the Appalachians are typically shown in this area.

These are the Piedmont Plateau on the east, the Appalachian Mountains, including the Blue Ridge and joining the Appalachian Valley northwest of the mountains, and, still farther northwest, the Appalachian Plateau, including the Cumberland and Allegheny plateaus.

Southeastward from the Blue Ridge the streams flow directly to the Atlantic in most of the area, northwestward from it they flow into the Appalachian Valley, and southwestward along the valley into Alabama. Most of the drainage of the Appalachian Plateau is dendritic and flows northwestward into the Ohio River from the eastern margin of the plateau.

The characteristic topography of the Piedmont Plateau is a smooth, even-topped upland into which the stream channels are rather deeply dissected. The Appalachian Mountains, from maximum heights of 6,600 and 6,700 feet in western North Carolina, become gradually lower toward Alabama and Virginia. Around their southern end the Piedmont Plateau merges with the Appalachian Valley. The same is true in less degree in Virginia. The Mountains are rugged and deeply dissected, especially where they rise abruptly from the Appalachian Valley. The great Appalachian Valley is a composite of many small valleys, separated by sharp linear ridges and mountains. The valleys follow the beds of soft rock and the ridges the hard sandstones. The height of the valley is greatest (about 2,000 feet) in southern Virginia and descends in either direction to about 500 feet in Alabama and northern Virginia. The Appalachian Plateau in Tennessee and Alabama are typically flat, table-topped mountains, more or less dissected by stream gorges and narrow valleys. They are preserved from erosion by beds of hard sandstone. In Kentucky and farther north the sandstones are less prominent and the region is extensively dissected into a network of hills and knobs. The summits of these, however, fall in general into planes.

Only the larger rock divisions were shown in color on the model. These corresponded in the main with the great time divisions—Cambrian, Ordovician, etc. The Carboniferous was shown in two divisions, the Pennsylvanian and Mississippian, and the Cambrian was divided into a lower siliceous and upper calcareous group. The Archean was divided into gneisses and igneous rocks. These greater divisions correspond closely with the great geographic divisions, the topographic features, in fact, being very largely determined by the progress of erosion on the different formations, according to their solubility. Thus, the Appalachian Plateau is formed mainly of Pennsylvania sandstones and shales with bordering zones of the Mississippian limestone. The Appalachian Valley is underlain in the main by narrow bands of the Devonian, Silurian, Ordovician and the calcareous division of the Cambrian rocks, while along its southeast border lie the siliceous Cambrian rocks. These also form the northwestern part of the mountains in a comparatively narrow band extending throughout the Appalachian system, with a few outliers farther southeast.

The main mass of the mountains is composed of gneisses through which have been injected igneous rocks of various descriptions—mainly granites. These rocks are, for the most part, Archean, but include also some of Algonkian age. They extend southeastward over the Piedmont Plateau in broad areas. Over the plateau there are also found large masses of later igneous rocks of approximately Carboniferous age. In this respect the Piedmont Plateau resembles the eastern part of the Appalachian province in New England. Other resemblances are seen in central Virginia and North Carolina, where sediments of Silurian age are found. Knowledge of these parts of the Appalachians is at present very limited. Over the Piedmont also are isolated basins of Triassic red sandstones and shales.

The Appalachian structures also fall into main groups similar to the geographic and geologic features. The Appalachian Plateau is underlain by rocks which are nearly flat. In the valley all of the formations are steeply folded, overturned, and, in places, faulted. The local changes in the extent and type of deformation express the differences in the character of the rocks. Open folding at the

north progresses into steeper folding southwestward, then into faulted folds and overthrusts, until in southern Tennessee and northern Georgia faults are much more prominent than folds. Huge overthrusts of many miles throw extend from lower Virginia into Georgia. These have been folded and faulted by later deformation. In the mountains similar structures prevail and metamorphism is added thereto. This increases rapidly toward the southeast and in large areas has destroyed the original aspect of the formations.

These structures were produced by tremendous force which thrust the pre-Cambrian masses northwestward against the sediments. According as these masses were unequally advanced the sediments were deformed and the great bends of the Appalachian Valley produced. Most of the structures run for great distances in parallel lines, but there are many cross folds extending across the valley and mountains.

Deformation was active in pre-Cambrian time, appeared in less degree at several times during the Paleozoic, and culminated in the post-Carboniferous Appalachian revolution. The Piedmont Plateau shared to some extent in the deformation of Triassic time, but the rest of the region appears to have escaped. Still later uplifts have appeared at various times up to the Quaternary and can be traced through the topographic forms. The land was uplifted and warped in broad levels or domes.

The Plateau Region: Mr. M. R. CAMPBELL.

The Appalachian Revolution: Mr. BAILEY WILLIS.

Assuming that the geologic structure of the Appalachian zone is too well known to require any descriptive statement, Mr. Willis proceeded to discuss the larger problems of the nature and origin of the movement involved in Appalachian folding. He referred to the hypothesis which he had once entertained of a movement of the interior continental region from northwest to southeast, a movement supposed to be of such a character that the mass of ancient crystallines in North Carolina formed the buttress against which Paleozoic strata were folded. He gave reasons for abandoning this view and accepting that which is more generally entertained, of a movement from the southeast toward the northwest. Tracing this northwestward movement, he showed that all of the known mass of the continent southeast of the Appalachian zone had been involved in it; that we must suppose a belt a thousand miles long and several hundred miles wide to have moved northwestward between thirty and forty miles. With reference to such displacement of the continental margin, he stated his belief that it involved the expansion of a sub-oceanic sector. Developing this idea by illustration of continental compression in North America and Asia, he stated a general theory that since an early geologic date, continents have from time to time been compressed in consequence of the expansion of the material beneath the oceanic basins, and he attributed this expansion to the plastic flow of rocks considered as rigid solids, which are nevertheless not sufficiently firm to maintain their form as masses of oceanic extent and one hundred miles or more deep. This property of plastic movement would apply equally to sub-continental as to sub-oceanic masses, but in view of the greater density of the latter, the motion has been from the oceanic toward the continental areas.

Economic Conquest of the Southern Appalachian Coal Field: Mr. GEO. H. ASHLEY.

Mr. Ashley traced briefly the movements resulting in the populating of the district, pointing out some of the factors affecting that movement, the routes by which it took place and the relation of those routes to the physiography. He then reviewed briefly the early efforts in marketing the coal by the use of the rivers reaching from the Ohio up into the coal fields, pointing out the difficulties encountered and how these were overcome by building dams and locks. Then came a study of the gradual incoming of railroads in which he pointed out the relation of the routes chosen to the physiography, some of the difficulties encountered, and the territory opened up to export as a result.

RALPH ARNOLD,
Secretary

THE NEW YORK ACADEMY OF SCIENCES

At the meeting of the Section of Geology and Mineralogy, January 7, the following paper was presented:

Volcanoes of Colima, Toluca and Popocatepetl: Edmund Otis Hovey.

Toluca is the oldest of the three volcanoes. A feature of greatest interest in the crater is the dome of vitreous andesite which welled up in the crater as the latest phase of the activity of the volcano and shows a certain resemblance to the cone of Mt. Pelé, with regard to origin. The volcano of Popocatepetl shows its composite character as a strato-volcano in the walls of the crater, and streams of lava have been among the features of the most recent eruptions. The volcano of Colima is still sending up a vigorous column of steam from its central summit crater. From this summit crater there poured out, in the latest eruption (1903), streams of very frothy lava which present a strange appearance on account of the porous character of the surface blocks. The same feature characterizes the streams of the earlier eruptions and has led some observers to the erroneous conclusion that flows of lava have not occurred at the volcano of Colima.

The major portion of the evening was then devoted to an examination of the exhibits of geology, paleontology and mineralogy in the New York Academy of Sciences Exhibition, under the guidance of the committeemen in charge of those exhibits.

At the meeting, April 1, Mr. Robert T. Hill gave a discussion of the tectonic structure of the northern part of the Mexican Plateau, which was published in Science for May 3.

Dr. Alexis A. Julien then spoke on the 'Evidence of the Stability of the Rock Foundations of New York City.' The general facts were reviewed which might justify the confidence of builders in the operations of extensive construction now in progress. Two former periods of enormous seismic activity in this region were considered, as recorded by the violent faulting produced at each time. The one, connected with the foldings, slips and shattering during the great Appalachian uplift, and now revealed by the numerous pegmatite intrusions cutting irregularly across the stratum of crystalline schists, probably effected during Cambrian time. The other, after the close of the Mesozoic, during the thrust of lava sheets between the sandstones and shales of the Newark series of New Jersey, now indicated by many faults across Manhattan Island and the adjacent Palisade Ridge. The long period of cessation of uplift, of ensuing subsidence and extensive surface erosion, offers the conditions in this region which promise long stability, notwithstanding the slight tremors noted at intervals of thirty or forty years. In the absence of disturbance of the glacial striæ, everywhere abundant, which serve as natural benchmarks to record changes of level or faulting, we obtain therefore direct testimony to the established absence of tremor during the long and approximately definite period which has elapsed since the passage and withdrawal of the continental glacier. In other parts of the Hudson River valley, however, some evidences of post-glacial faulting have been observed.

Alexis A. Julien,
Secretary of Section

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 172d meeting was held in the main lecture room of Chemistry Hall, Tuesday, April 16, 7:30 P.M., with the following program:

Professor Archibald Henderson: 'The Foundations of Geometry.'

Professor Chas. H. Herty: 'The Optical Rotation of Turpentines.'

Alvin S. Wheeler,
Recording Secretary

DISCUSSION AND CORRESPONDENCE

THE CLOCKS OF THE GREENWICH AND U. S. NAVAL OBSERVATORIES

To the Editor of Science: In Professor Eichelberger's paper, published in your issue of March 22, 1907, he gives a comparison of the performance of six clocks, at various periods from the time of Bradley in 1750.

This table is primarily intended to show the

improvement made in one hundred and fifty years; but incidentally it brings out an apparently strong contrast in the performance of the clocks in use at Greenwich Observatory and the Naval Observatory, Washington. Clocks can now be made to give, under ordinary conditions, very fair and steady rates; but if greater excellence is required, than beyond the best possible mechanical construction, means more or less independent of the clock, as such, have to be devised to obtain it. For instance the Greenwich clock is kept in a room in which the temperature does not vary more than 5° F., and it has an automatic device to correct for barometric error. Thus its conditions are practically the same as those of the Washington, although attained by different means. The Washington clock is kept in an air-tight case in a room whose temperature varies say 5° C. A comparison then of the actual performances of these two clocks is of great interest. Professor Eichelberger's figures on page 451 fail to do this, and for these reasons:

1. The Greenwich Clock rates are spread over a period of one year, while those of the Washington clock only extend over three selected months.

2. The quantity ˢ.015 given in the table in the second column on page 451 is not comparable with ˢ.051 given for the Greenwich clock.

ˢ.051 is the mean deviation of the observed rate.

ˢ.015 is the mean deviation of the observed rate from one calculated from formulæ, and hence quite distinct from ˢ.051.

Professor Eichelberger, while admitting that his comparison is not valid, appears not to realize that it is altogether vitiated by dealing with periods of widely different deviation, and the fact that ˢ.051 and ˢ.015 represented two distinct phenomena seems to have escaped his notice.

It is, however, from the material he gives a simple matter to make such a comparison: the rates are taken from the table on page 451, and the column 'mean deviation' exhibits the difference of the separate rates from the mean rate +ˢ.016.

For the Greenwich clock the corresponding period of 1904 is first given, and in addition the same period of 1905.

It will be seen that the difference is really in favor of the Greenwich clock.

U. S. NAVAL OBSERVATORY CLOCK

1904		Mean Daily Rate s.	Mean Deviation s.
Feb.	8–11	+ .019	.003
	11–15	— .014	.030
	15–20	+ .005	.011
March	1– 4	— .026	.042
	4– 9	— .010	.026
	9–16	— .022	.038
	16–18	— .043	.059
	18–22	— .022	.038
	22–25	— .029	.045
	25–28	+ .002	.014
	28–34	— .007	.023
April	3– 5	+ .017	.001
	5–13	+ .002	.014
	13–16	+ .026	.010
	16–19	+ .034	.018
	19–22	+ .002	.014
	22–31	+ .029	.013
May	1– 4	+ .113	.097
	4– 7	+ .082	.066
	7–12	+ .161	.145
	Mean	+ .016	± .035

Range 0ˢ.204.

GREENWICH CLOCK

1904		Mean Daily Rate s.	Mean Deviation s.
Feb.	8–12	+ .110	.078
	12–15	.123	.065
	15–19	.135	.053
March	1– 3	.180	.008
	9–16	.203	.015
	16–18	.235	.047
	18–22	.180	.008
	22–25	.206	.018
	27–30	.156	.032
	30–Apr. 1	.180	.008
April	1– 5	.191	.003
	5–13	.207	.019
	13–16	.223	.035
	16–19	.240	.052
	19–22	.227	.039
	24–29	.192	.004
May	1– 4	.220	.032
	4– 7	.207	.019
	7–12	+ .158	.030
	Mean	+ .188	± .030

Range 0ˢ.130.

GREENWICH CLOCK

1905		Mean Daily Rate s.	Mean Deviation s.
Feb.	1– 4	—.243	.016
	6–12	.225	.002
	12–21	.225	.002
	21–March 1	.258	.031
March	2–12	.228	.001
	12–18	.220	.007
	18–24	.200	.027
	24–Apr. 1	.217	.010
April	1– 8	.222	.005
	8–16	.222	.005
	16–23	.178	.049
	23–May 1	.232	.005
May	1– 6	.248	.021
	6–12	—.274	.047
	Mean	—.227	±.018

Range $0^s.096$.

THOMAS LEWIS

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REASONS FOR BELIEVING IN AN ETHER

SEVERAL weeks ago an article with this title appeared in SCIENCE. In it were mentioned two reasons for the belief in an ether; but what seems to me the most powerful of all arguments was not mentioned, nor is it often referred to elsewhere. It is alluded to by Maxwell in his article 'Ether,'[1] where we find these words:

> In the next place, this energy is not transmitted instantaneously from the radiating body to the absorbing body, but exists for a time in the medium.

The ether was originally invented to avoid the assumption of action at a distance; but there are no insuperable objections to action at a distance *provided it be instantaneous.* Herein lies the point of the argument. We have replaced the old question: "Can a body act *where* it is not?" by the far more searching question: "Can a body act *when* it is not?"

The energy sent out by the sun, for instance, reaches the earth after a lapse of some eight minutes. What of the energy during that time? The principle of the conservation of energy forbids our supposing that it is annihilated and recreated eight minutes later; and it will hardly be urged, I think, that it exists as a sort of disembodied spirit during that interval. There must be some medium in which it may reside during its finite time of passage from place to place.

The ether stands or falls with the principle of the conservation of energy.

PAUL R. HEYL

[1] Encyc. Brit., ninth edition, Vol. VIII., p. 570.

THE FIRST SPECIES RULE

THE article by Professor John B. Smith in the May 10 number of SCIENCE under the above title, in which exception is taken to the operation of the first species rule in the case of the lepidopterous genus *Rhynchagrotis* Smith, can hardly be considered as an argument against the use of this method of type fixing. His objection is against the selection of a doubtfully referred species as the type of a genus, a matter which is fully covered in most, if not all, codes and is *entirely independent* of the *method* of selecting types, whether by elimination or first species rule.

In the specific case mentioned by Professor Smith we fail to see that the species *chardinyi* selected as the type by Sir George Hampson was 'questionably referred,' as in the original description Professor Smith says: "The group, though placed with, and certainly very closely allied to *cupida,* yet shows so many peculiar characteristics that it would seem possible to separate it by a distinct generic term. The two species *rufipectus* and *brunneicollis* are, however, somewhat intermediate and as the species (*chardinyi*) can hardly be referred to *Triphæna,* I prefer to leave it here." Regarding this Professor Smith states in his recent article: "my reason for placing it there being that I believed it would prove to be properly referable to an exotic genus to which I did not care to risk making a synonym."

JAMES A. G. REHN

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA, PA.,
May 17, 1907

SPECIAL ARTICLES

SOME MUTUAL EFFECTS OF TREE-ROOTS AND GRASSES ON SOILS[1]

It is commonly noticed that plants of the Gramineæ do not grow readily under certain species of trees, and while many reasons have been assigned, there does not seem to have been much systematic experimentation to determine the principal causes.

Shade thrown by the trees themselves has been commonly mentioned as an important factor. Considerable shade in itself will retard the growth of many grasses, but it is hardly probable this is important in the case of single trees; moreover, the shaded area varies with the time of day, and the grass receives light much of the time. Also, if shade is an important factor, why does not the grass live on the sunny side of the tree? Near the base of the trunk of low-branched trees this might become a controlling factor.

Another reason commonly assigned is the removal of 'plant food' by the tree, thus starving the grass. As the parts of the tree roots most active in removing soluble salts from the soil water are the newer root tips and branches, it hardly seems that these could be held responsible for the almost entire removal of plant food over the entire affected grass space. They would, at any rate, not usually be active for some distance from the tree trunk, and though roots may here be near the surface or even exposed, they play no active part in the removal of mineral constituents from the soil. As the soil solution is practically a constant as regards the amount of salts in solution, it would seem that were the removal of plant food by the tree very excessive, there would still be sufficient available for the grass owing to the nature of the solubility of soil minerals. As, however, it would be impossible to say in just what quantity and in what combination the plant food should be present for the best development of tree and grass, respectively, this factor of plant food removal is difficult definitely to rule out.

Another reason assigned, and perhaps the more logical, is the removal of water from the soil by the tree. The average sized tree during active growth transpires an enormous amount of water, especially if the season be hot and dry; but so does the grass, and it would be about as logical to blame the grass for removing so much water from the soil as to cut short the available supply for the tree. Here again, the root system for some distance from the tree does not play an important rôle in absorption of water. These possibilities of plant food and water removal would seem to be negatived by the experiments at Woburn to be mentioned later.

While all these factors working in conjunction may produce an effect on the growth of grass, there seems to be a much deeper underlying principle involved.

During some experiments carried out on a lawn in Takoma Park, Md., where a few scattered oak, chestnut and pine trees are growing, it was found almost impossible to obtain a stand of grass or clover. Beds were spaded up, stable manure applied and later artificial fertilizers added and the best of care given the plots. The grass and clover (the latter also inoculated with nitrogen bacteria) came up very well and for a time gave promise of a good stand, but in a month or two all died in spite of good care. When the plots were originally spaded up, many tree roots were encountered which were removed; the soil being shallow, these naturally live near the surface. The plots on which the grass had died were later spaded up again and found to be almost entirely filled up with young actively growing roots, the special preparation of the soil having been very favorable for their growth.

As the lawn is everywhere permeated with roots (though the trees are not close enough to form a dense shade) it was thought that these might have some malignant influence on the grass. It has been shown that washings from tree trunks and tree leaves are injurious[2] to plant growth, which might account for some of the trouble experienced in trying to obtain a stand of grass, but as the trees do

[1] Published by permission of the Secretary of Agriculture.

[2] Bull. 28, U. S. Department of Agriculture, Bureau of Soils.

not cover the entire lawn area, this cause could not be the only one. The converse effect, *i. e.*, a deleterious effect of grass on trees, was found by the Duke of Bedford and his co-workers.[3] In 1897 they began to notice the peculiar effect produced by grass upon their fruit trees, especially apple and pear trees. The soil on this farm is shallow, eighteen to twenty-four inches of soil overlying an impervious calcareous subsoil.

Their first supposition was the removal of plant food, and so they inaugurated experiments to determine if this assumption was correct, but all their experiments answered the question in the negative. They then tried if the removal of water by the grass was the cause, but here again they received a negative answer. They tried the effect of carbon dioxide on the tree roots, thinking this might be given off in such large quantities by the grass as to be harmful. This not proving to be the cause, they tried the effect of the exclusion of oxygen, and also of the effect of packing imitating the impervious sod, but in all cases they were baffled, finding no evident effect of any of these factors on the trees.

Having ruled out all the above-mentioned factors, they found by other experiments that only the most actively growing portions of the tree root system was affected by the grass. A circular sod of a few feet in diameter around the tree had no effect, but as the circle was increased, the tree began showing the detrimental effect, viz., premature falling of the leaves, and entire change of the normal ripe color of the fruit, from green to red, and a dwarfing of the tree. In very many instances the trees were killed outright. They also found by excavating the ground around the trees and by removing the root system, that the pernicious effect of the grass was strongly marked even when only one thousandth to two thousandths of the root system of the tree was exposed to the action of the grass.

They finally, after about seven years' work, concluded the pernicious effect of the grass could be due only to some poisonous substance formed in the soil around the tree roots, leaving the question open as to whether these substances were due to direct excretions from the grass or to a changed bacterial action in the soil induced by the presence of the grass.

Jones and Morse[4] have described a similar relation existing between the shrubby cinquefoil (*Potentilla fructicosa*) and the butternut tree (*Juglans cinerea*), the latter killing the former for an area equal to and often much greater than that of the tree top. Excavations showed in every case of the dead or dying cinquefoil that the butternut tree roots were in close physical relation with those of the shrub. Young birch, beech, maple, cherry, apple and pine trees growing among the cinquefoil in the same field had no such influence on the latter. More recently an antagonism between peach trees and several herbaceous plants, commonly used as cover crops in orchards, has been reported by Hedrick.[5]

In work done in these laboratories, Reed found unquestionable evidence that plants do produce toxic conditions in the medium in which they grow. Agar in which wheat had grown was decidedly toxic to a second crop of wheat. Agar in which corn or cowpeas had grown was scarcely, if at all, toxic to wheat, Agar in which oats had grown was quite toxic to wheat, but not as toxic as that in which wheat itself had previously grown. Apparently excretions from the roots of a given plant, or its near relatives, are more toxic to that species than the excretions from plants belonging to more distantly related species.

It was decided to try the effect of tree seedlings on the growth of wheat under control of external factors, and accordingly a number of tree seedlings were dug up in the forest in the early part of June, 1906. The species gathered were pine, tulip, maple, dogwood, and cherry, and varied in height from about 15 to 40 cm., care being taken to get the entire root system. These were planted in paraffined wire pots,[6] using soil already made

[3] Woburn Experimental Fruit Farm, 3d Rept., 1903, and 4th Rept., 1904.

[4] Rept. Vt. Expt. Sta., 16 (1903), 173–190.

[5] *Proc. Soc. Hort. Sci.*, 1905, 72.

[6] This method of pot culture is fully described in Cir. No. 18, Bureau of Soils, U. S. Dept. of Agriculture.

up to optimum moisture condition. The water content was kept up subsequently by frequent watering. These pots, along with two controls, were put into the greenhouse and left standing for about two weeks before planting to wheat in order to enable the tree roots to become established in the soil. At the end of this time, all pots were planted to wheat, putting the same number of germinated wheat seeds in each pot.

The first crop of wheat was cut down at the end of about three weeks and weighed and the pots immediately replanted without disturbing the soil. The wheat was similarly planted and harvested every two or three weeks until the middle of December, by which time nine crops had been removed. In each crop the average green weight of the plants in the controls was considered 100, and the relative weights of the others calculated on this basis. The accompanying table shows the tabulated results of the successive crops. There is plainly a decrease in the green weight of the plants grown in the pots with the trees. This can not be due in any way to shade, as the seedling trees were not large enough to interfere in this way, and the pots were all arranged in a row, so all had an equal amount of light. The water content can not be a factor, either, as all were watered every day or two during the hot summer and every three or four days during the cooler autumn. The 'plant food' removed can hardly be considered a serious factor in the case of such small seedlings, especially as the crops increase again, as will be pointed out below, and there were of course no leaf washings from the trees to affect the wheat.

It seems, therefore, that the presence of the roots must have had some other effect on the growth of the wheat, as the size of the pots made it necessary for the two kinds of roots to be in close physical relation. That the retarding effect is due to substances excreted by the tree roots seems probable, and a closer inspection of the table shows an evident increase in yield toward autumn when the physiological activities of the trees were diminished by their entering upon their seasonal rest. It was also noticed that the tree pots that produced as much wheat growth in November as the controls were the ones in which the trees showed the earliest signs of winter rest. Attention should be called to the fact that if the tree seedlings removed sufficient plant food to starve the wheat plants in the summer period, the increase in yields toward autumn would hardly be looked for.

The increase in wheat growth in the various pots toward autumn is more clearly brought out in the last two columns. The first shows the average of the preceding six crops, which brings the time up to the middle of October, about the time the physiological activities of the trees would be decreasing, as the crop harvested October 13 was not planted until about September 20. The second of these columns shows the average of the last three crops.

It will be seen that there is a decided increase in the average yield of these three crops over the average of the preceding summer crops, except in the case of the dogwoods, and they were, excepting the pine, the last to drop their leaves, having only dropped them

RELATIVE GREEN WEIGHTS OF WHEAT CROPS, GROWN IN ASSOCIATION WITH TREE SEEDLINGS

Date of Harvesting.	6/29	7/12	8/1	8/22	9/6	10/13	10/29	11/19	12/8	Average of First 6 Crops (Summer)	Average of Last 3 Crops (Autumn)
Control	100	100	100	100	100	100	100	100	100	100	100
Maple 1	76	65	86	68	67	86	92	91	96	74	93
Maple 2	44	86	75	59	71	89	90	75	109	71 } 72	91 } 92
Maple 3	21	83	72	72	79	84	81	103	92	70	92
Dogwood 1	92	96	76	84	71	65	83	68	115	81 } 79	89 } 91
Dogwood 2	86	79	63	86	75	73	84	107	88	78	93
Cherry	81	91	102	91	71	94	88	102	93	88	94
Tulip	21	106	82	77	68	100	77	109	103	76	96
Pine	55	69	68	52	54	80	62	83	60	63	68
Pine (dead)	62	96	85	91	80	89	97	96	67	84	87

when the last crop of wheat was removed on December 8.

An interesting case is that of the two pine seedlings. During the growth of the first crop one of these died, and the pot with the dead seedling left intact was carried on in the set and treated in the same way as the other cultures. The greater yield in this pot over that in the pot containing the live pine is clearly evident.

Another feature is the variation in yield obtained in the pots with different species of trees. It would appear that the cherry was least active in checking growth of wheat, the dogwood next, followed by the tulip, then maple, and most of all, live pine, although it would not be safe to assume this same order would obtain in the field.

It should be mentioned that in replanting the wheat, the soil was disturbed only enough to accomplish this, so the organic matter left by the wheat roots would act as a light application of green manure, although it is well known that wheat is not very effective as green manure. This would perhaps help slightly to counteract the deleterious effect of the tree roots on the wheat, but the aim was to leave the soil undisturbed.

Summarizing the foregoing, we find that seedling trees of tulip, dogwood, maple, cherry, and pine retard growth of wheat when the latter is grown under conditions making it necessary for the wheat roots to be in close physical relation with the tree roots. That this retarding effect differs with different species of tree seedlings, that the checking of wheat growth is greatest during the season when the tree seedlings are most active physiologically, and this checking effect becomes less as the season of physiological inactivity of the trees is approached. That in the case of pine, at least, the live pine is much more detrimental to wheat growth than the dead pine.

This injurious effect of trees on wheat appears to be due to the excretion of substances by the trees, toxic to wheat growth.

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NOTES ON ORGANIC CHEMISTRY

FORMATION OF FUSEL OIL

THE production of fusel oil during the course of the ordinary alcoholic fermentation involves grave practical difficulties to the manufacturer of distilled spirituous beverages, because the removal of this constituent entails a considerable expense. To the pure chemist also, this formation of fusel oil is of importance because it, apparently, complicates the chemical changes involved in the course of fermentation. The conversion of grape sugar, $C_6H_{12}O_6$, into alcohol, $2C_2H_6O$, and carbon dioxide, $2CO_2$, is very simple, but to account for the production of small, variable amounts of amyl alcohol and similar substances compels the use of quite complicated equations. The difficulties of both the brewer and the chemist will be lessened, or wholly removed by some highly interesting work which Felix Ehrlich[1] has carried out in the Berlin Institution of Sugar Industry. He has fermented pure sugar solutions with pure yeast cultures and obtained, on an average, about 0.4 per cent. of fusel oil. The addition of *l*-leucine,

$$\genfrac{}{}{0pt}{}{CH_3}{CH_3}{>}CHCH_2CH(NH_2)CO_2H,$$

or of *d*-isoleucine,

$$\genfrac{}{}{0pt}{}{CH_3}{C_2H_5}{>}CHCH(NH_2)CO_2H,$$

to the fermenting material immediately raised the content of fusel oil to 3 per cent. The former compound gave inactive amyl alcohol,

$$\genfrac{}{}{0pt}{}{CH_3}{CH_3}{>}CHCH_2CH_2OH,$$

and the latter, optically active, dextro-rotatory amyl alcohol,

$$\genfrac{}{}{0pt}{}{CH_3}{C_2H_5}{>}CHCH_2OH.$$

On comparing the formulæ it will be observed that the alcohols can be formed from the leucines by the addition of the elements of water and the elimination of ammonia and carbon dioxide.

The latter substance is, of course, evolved, and the question arises as to the fate of the ammonia. Special experiments showed that the fermenting liquid and the gases issuing from it were free from ammonia and nitrogen,

[1] *Ber. d. chem. Ges.*, **40**, 1027 (1907).

and that the amount of amyl alcohol formed was equivalent to the quantity of leucine which disappeared in the course of the reaction. It follows, therefore, that the ammonia must be absorbed by the yeast as rapidly as it is produced and be converted into insoluble albuminoid material.

Evidently the formation of fusel oil is dependent on the assimilation of nitrogen by the yeast and it was found, by further experiments, that the addition of asparagine, $H_2NCOCH(NH_2)CH_2CO_2H$, or of certain ammonium salts such as the carbonate or sulphate, all of which liberate ammonia far more readily than the amino-acids, such as the leucines, almost completely prevents the formation of fusel oil. The results were the same irrespective of the kind of yeast employed and of the presence or absence of leucine from the mixture. Solutions of ordinary molasses behaved like those of pure sugar. The formation of fusel oil under industrial conditions appears, therefore, to be due essentially to the presence of amino acids in the mash, and not to those which the yeast contains. It is also obvious that the removal of these acids is not necessary for the prevention of the formation of fusel oil.

The same chemist has also carried out a number of experiments on the production of certain higher and more complicated alcohols from amino acids, in the presence of fermenting sugar. He finds that the action is a general one and that it appears to resemble certain activities in plants. Thus, from phenylalanine, $C_6H_5CH_2CH(NH_2)CO_2H$, he obtained phenylethyl alcohol, $C_6H_5CH_2CH_2OH$, which is the chief constituent of the odoriferous material of the rose.

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BOTANICAL NOTES

HOW TO STUDY THE FUNGI

GEORGE MASSEE, the well-known mycologist of Kew, has brought out a useful 'Text-book of Fungi' (Duckworth and Company, London), which is intended to serve as an introduction to those new lines of research included in the morphology, biology and physiology of the fungi, 'and also to indicate where fuller information may be obtained.' The reader will observe that the book is not, like some of its English predecessors, a book of *information,* only, but it is intended to foster investigation and research, in accordance with present-day ideas as to the proper function of a text-book for advanced students. For it must be remembered that this is no elementary presentation of the subject for children in the secondary schools, or others who have not had a good preliminary training in the 'general botany' courses in the college or university. It is, on the contrary, a book for the college or university student who has already acquired a good general notion of the fungi, and their relations to other members of the vegetable kingdom, and who is now ready to take up their particular study.

The book is roughly divided into three parts: I., Morphology, Physiology, Biology, etc. (195 pages); II., Pathology (36 pages); III., Classification (183 pages). In the first, such topics as the cell, anatomy of fungi, formation of spores, sexual reproduction, asexual reproduction, effect of light, effect of low temperature, respiration, transpiration, enzymes, parasitism, symbiosis, heteroecism, mycoplasm, chemotaxis, geographical distribution, ecology, phylogeny, etc., are taken up at greater or less length, and it is safe to say that any properly prepared student who carefully goes over this part of the book will do so with great profit, and will get a very good modern understanding of these plants. In the second part the student finds helpful discussions of the diseases caused by fungi, the spread of disease by means of hybernating mycelium, legislation against disease-producing fungi, etc. The third part opens with a discussion of the classifications of the fungi, followed by a systematic account of the orders and families. The author arranges all fungi under six orders, namely; Phycomycetes, Hemiascomycetes, Ascomycetes, Hemibasidiomycetes, Basidiomycetes, Deuteromycetes. The text is illustrated with 141 figures, which add much to the usefulness of the book.

A NEW EXPLANATION OF THE TOLERANCE AND INTOLERANCE OF TREES

Before a recent meeting of the Society of American Foresters Mr. Raphael Zon read a paper presenting the new explanation of the tolerance and intolerance of trees.

The theory of tolerance as formulated by Pfeil and Gustav Heyer and the classification of trees into light-needing and shade-enduring is the foundation upon which the forester bases all his practical work in silviculture. Many biological, ecological and silvicultural facts have, however, been accumulating which tend to show that the increased growth of trees after thinning or the possibility of securing reproduction of certain species only in full light or after heavy thinnings, are due chiefly to temperature and moisture condition, and, not, as has been supposed, to light requirements. It has been found, for instance, that the same structural differences which occur between trees growing in the open and trees growing in the shade, such as the reduction of leaf surface, the diminution of intercellular spaces, the lengthening of the palisade cells, etc., occur also between trees growing in dry or in moist situation, or in a dry or humid atmosphere. It has also been observed that trees within the same climatic region are more tolerant of shade when grown in fresh or moist soils, than when grown on dry or poor soils.

Fricke, a German silviculturist, has proved recently by a number of very interesting and convincing experiments that the failure of Scotch pine to grow under the shade of mother trees was not due to lack of light, but to deficiency of moisture, which is a result of competition with the roots of the larger trees.

In a stand of pine about one hundred years old, with a crown density of 0.7, growing on poor sandy soil, where the light requirements of pine are greatest, a number of isolated groups of suppressed young pines were located. The young pines were ten years old and about a foot and a half high. These groups were surrounded by ditches so that the roots of the neighboring large trees were cut through to a depth of ten inches. The little trees within the ditched areas immediately responded. The needles had double the length of the preceding summer, the terminal shoots became longer and the growth generally thrifty and has continued so, while the young growth not surrounded by ditches retained the same suppressed character. Subsequently he determined by analyses that the soil moisture content in the areas surrounded by ditches was from 30 to 40 per cent. higher than that on contiguous areas not ditched and penetrated by the roots of living trees.

It must, therefore, be conceded that the moisture conditions play an extremely important part in determining the behavior of trees growing in shade and in light, and that the rôle which light plays is by no means an all-important one. The theory of the tolerance and intolerance of trees as hitherto understood is not tenable and must be thoroughly revised.

A LABORATORY MANUAL

Some time ago Bergen and Davis's book entitled 'Principles of Botany' was noticed in these columns (Science, January 25, 1907). We have now a companion or supplementary volume in the 'Laboratory and Field Manual of Botany' (Ginn) by the same authors, intended for the use of pupils in high schools, and perhaps in the smaller colleges. It includes ten or eleven chapters on such topics as laboratory methods and equipment (full of excellent suggestions); structure and physiology of seed plants (accompanied with forty-two suggestive experiments); type studies, preceded by the study of the plant cell (beginning with simple forms and passing regularly to higher and higher types); ecology (accompanied with many studies); botanical microtechnique (full of excellent advice); culture methods (containing much of great practical value); material, apparatus, and supplies (a most helpful chapter for the teacher); bibliography (carefully classified); glossary, etc. The book is so evidently the result of years of experience by the authors in the supervision of botanical laboratory work that we are not surprised at its air of practicality and work-

ableness. It must prove most useful in the better class of high schools.

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LINNÆUS AND THE NEW YORK ACADEMY OF SCIENCES

THE commemoration on May 23 by the New York Academy of Sciences of the two-hundredth anniversary of the birth of Linnæus took place in accordance with the program that has already been printed in SCIENCE. In the morning exercises were held in the American Museum of Natural History, where there was an exhibition of animals and minerals known to Linnæus; a presentation of letters by delegates from other societies, and an address by Dr. J. A. Allen on 'Linnæus and American Zoology.' After luncheon had been served to invited guests, the exercises were resumed in the New York Botanical Garden, where there was an exhibition of American plants known to Linnæus; an address by Dr. P. A. Rydberg on 'Linnæus and American Botany,' and lantern slides of American flowers known to Linnæus were exhibited by Dr. H. H. Rusby. In a walk through the garden, trees known to Linnæus were pointed out by Dr. W. A. Murrill. Later the bridge over the Bronx River on Pelham Parkway between the Botanical Garden and the Zoological Park was dedicated in memory of Linnæus and a bronze tablet was unveiled. The tablet was presented by Dr. N. L. Britton, president of the New York Academy of Sciences, and was accepted by the commissioner of parks of the Bronx. Addresses were also made by Dr. George F. Kunz, president of the American Scenic and Historic Preservation Society, and by Mr. Emil F. Johnson, president of the United Swedish Societies of New York. There was singing by the American Union of Swedish Singers, and the Swedish minister to this country and the Swedish consul of New York City were present. Subsequently there was an exhibit of animals known to Linnæus in the New York Zoological Park. In the evening the exercises were continued at the Museum of the Brooklyn Institute of Arts and Sciences, addresses being made by Mr. F. A. Lucas and Mr. E. L. Morris. There was a reception at the New York Aquarium given by the New York Zoological Society to the New York Academy of Sciences. The committee of the New York Academy in charge of the celebrations was: Nathaniel L. Britton, Hermon C. Bumpus, William T. Hornaday, Frederic A. Lucas, Charles H. Townsend, William Morton Wheeler.

SCIENTIFIC NOTES AND NEWS

M. DOUVILLE has been elected a member of the Paris Academy of Sciences in the section of mineralogy in the place of Bertrand.

PROFESSOR A. S. WARTHIN, of the University of Michigan, has been elected president of the American Association of Pathologists and Bacteriologists.

PROFESSOR CHARLES F. BURGESS, of the department of chemical engineering of the University of Wisconsin, was elected to the presidency of the American Electro-chemical Society at the fifth annual meeting held in Philadelphia.

ON the occasion of the centennial of the University of Maryland honorary degrees will be conferred as follows: Doctor of science—Dr. Henry D. Fry, Baltimore; Dr. Alexander C. Abbott, University of Pennsylvania; Dr. Henry J. Berkley, Johns Hopkins University; Edwin S. Faust, Strassburg; Dr. Isaac Stone, Washington, D. C.; Dr. Charles P. Noble, Philadelphia; J. Homer Wright, Harvard University; Dr. J. Whitridge Williams, Johns Hopkins University; Dr. N. G. Keirle, Baltimore. Doctor of laws—Dr. Wm. T. Councilman, Harvard University; Major-surgeon James Carroll, U. S. A., Washington, D. C.; Dr. Simon Flexner, Rockefeller Institute for Medical Research; Professor W. D. Halliburton, King's College, London; President G. Stanley Hall, Clark University; Dr. Francis L. Patton, Princeton, N. J.; Judge James McSherry, Frederick, Md.; Surgeon General Walter Wyman, U. S. N., Washington, D. C.; Dr. S. J. Meltzer, New York City; Professor William T. Porter, Harvard Medical School; Dr. William J. Mayo, Rochester, Minn.; Pro-

fessor William T. Howard, Baltimore; Professor C. A. Ewald, University of Berlin; Professor Samuel C. Chew, Baltimore.

Under a grant from the Smithsonian Institution, just approved by Secretary Walcott, Mr. Bailey Willis, of the United States Geological Survey, will be sent to Europe this summer to study the types of geological structure involved in the Alps. Mr. Willis will leave on the first of August for a two months' trip, during which he will make observations at the most important spots in Italy and Switzerland, and confer with a number of geological experts. On his return he will formulate his investigations into a report which will be published by the Smithsonian Institution.

Dr. David Eugene Smith, professor of mathematics of Teachers College, Columbia University, has next year his sabbatical year of absence, which he will spend mainly in Asia, making collections of manuscripts and instruments illustrating the history of mathematics.

Dr. C. R. Weiland, of the Peabody Museum, Yale University, has left for a stay of five months in Europe where he will visit the plant collections of northern and southern Europe for a special study of cycads. The results of his investigations will be published in his second volume on cycads.

Professor Liveing, for forty-six years professor of chemistry at the University of Cambridge, expects to retire next year.

Dr. Werner Janeusch has been appointed curator of the Geological and Paleontological Institute of the University of Berlin, and Dr. Otto Schneider has been given charge of the collections of the Geological Institute.

Professor Frederick C. Shattuck, of Harvard University, will give the annual address before the Medical School of Yale University on June 24, his subject being the 'Art and Science of Medicine.'

From May 6 to May 10 Professor R. H. Chittenden, director of the Sheffield Scientific School of Yale University, lectured at the University of Illinois on the general subject of 'Nutrition.' In the course of six lectures Professor Chittenden outlined our present knowledge of the physiology of nutrition, and gave a historical and critical discussion of dietary habits and experiments bearing on true food requirements. The general trend of the lectures was toward the conclusion that the most advantageous diet for man is one that includes a minimum of proteid material, *i. e.*, the amount actually needed to meet the physiological requirements of the body. A reception in honor of Professor Chittenden was held at the conclusion of the opening lecture of the series.

Mr. Charles F. Scott, consulting engineer of the Westinghouse Manufacturing Company, will give the commencement address on June 13 at the Worcester Polytechnic Institute, his subject being 'Some Aspects of Electrical Development.' The annual commencement lecture will be given on June 11 by Mr. A. S. Ritchey, a professor of electrical railway engineering, on 'The Electric Railway.'

The fifteenth 'James Forrest' lecture before the Institution of Civil Engineers, London, will be delivered by Dr. Francis Elgar, F.R.S., on June 18, his subject being 'Unsolved Problems in the Design and Propulsion of Ships.' The fourth engineering conference will be held on June 19, 20 and 21, and the annual *conversazione* will be held on the evening of June 20, at the Royal Albert Hall.

Beginning on May 23 Sir James Dewar is giving three lectures before the Royal Institution on Chemical Progress-work of Berthelot, Mendeléef and Moissan.

The fund for a memorial to the late Robert Henry Thurston, director of Sibley College, is now complete. This fund, started by the four classes in college at the time of Dr. Thurston's death, but since added to by other Sibley students, amounts to about $1,600. The memorial will be a bronze bust of Dr. Thurston by Herman Atkins MacNeil, of New York, formerly instructor in Sibley College. The bust will be placed in the central Sibley building.

The two-hundredth anniversary of the birth of Linnæus was celebrated at Augustana Col-

lege on May 13, the program being as follows: Biographical, J. A. Udden, Ph.D., of Augustana College; 'The Place of Linné in the Scientific World,' Charles E. Bessey, Ph.D., of the University of Nebraska; 'Vårsång' (spring song) by Prince Gustaf, the Wennerberg Chorus; 'Linné and the Love for Nature,' E. K. Putnam, A.M., of Davenport Academy of Sciences; remarks by Josua Lindahl, Ph.D., of Cincinnati Museum of Natural History, and P. A. Rydberg, Ph.D., of the New York Botanical Garden.

A SECOND series of tablets was unveiled in the Hall of Fame of New York University on Memorial Day, May 30. Addresses were made by Governor Hughes of New York and Governor Guild of Massachusetts. Among the twelve tablets unveiled was one in memory of Maria Mitchell, the astronomer, and one in memory of Louis Agassiz. The tablet in honor of Agassiz was unveiled under the auspices of the American Association for the Advancement of Science with brief addresses by Dr. Charles D. Walcott, secretary of the Smithsonian Institution, and Dr. Edward S. Morse, director of the Peabody Institute of Science.

THE Brooklyn Institute of Arts and Sciences commemorated the hundredth anniversary of the birth of Agassiz by a meeting on May 28. The principal address was made by Dr. Franklin W. Hooper, director of the institute.

SIR BENJAMIN BAKER, F.R.S., the eminent British engineer, known among other important works for the Forth Bridge in Scotland and the Assouan Dam, died on May 19, at the age of sixty-seven years.

DR. ALEXANDER BUCHAN, F.R.S., the eminent Scottish meteorologist, died on May 13, at the age of seventy-eight years.

LIEUT. GEN. ZACHARIAE, vice-president of the International Geodetic Commission, died at Copenhagen, on May 16, at the age of seventy-two years.

DR. GUY DAVENPORT LOMBARD, instructor in histology in Cornell Medical College, died in New York on May 22, at the age of thirty-five years.

GUY WARNER EASTMAN, assistant in physics in the Massachusetts Institute of Technology, was killed by a train in Boston on May 17. Mr. Eastman was engaged in researches under Professor A. A. Noyes and completed the work for the degree of doctor of philosophy. He was twenty-six years of age.

THREE Paris medical societies—the Société de Médecine et de Chirurgie Pratique, the Société de Médecine de Paris and the Société Médico-Chirurgicale—have combined together under the title of Société de Médecine. The first meeting of the new society was held on May 14 under the presidency of Dr. Paul Coudray.

THE Seismological Observatory, erected at the expense of the pope, was inaugurated on May 19 at Valla di Pompeii, near Naples. Father Alfani, director of the Florence Observatory, made the inaugural speech. Director Hagan and Vice-director Mannucci of the Vatican Observatory were present.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Maryland will celebrate from May 30 to June 2 the centennial of its foundation. On Thursday, May 30, there will be a reception of representatives from other universities, alumni and invited guests and in the afternoon an inspection of the buildings. On the following day there will be addresses by President Francis L. Paton, of Princeton Theological Seminary, and by President G. Stanley Hall, of Clark University, followed by the conferring of regular and honorary degrees. On Saturday there will be a reception at St. John's College, the academic department of the University of Maryland, when a large shield with the seals of the two institutions and the coat of arms of the University of Maryland will be presented to the college.

THE Michigan Agricultural College celebrated the semi-centennial of its foundation from May 26 to 31. On May 28 and 29 the annual meeting of the American Association of Agricultural Colleges and Experiment Stations was held at Lansing. On the twenty-ninth addresses were made on the 'College

and the State,' including an address by the governor of the state. The afternoon session on 'Builders of the College,' included addresses by Professor Charles E. Bessey, of the University of Nebraska, and by Professor W. J. Beal, of the college. The exercises on Thursday were under the auspices of the American Association of Agricultural Colleges and Experiment Stations and were presided over by Professor L. H. Bailey, director of the College of Agriculture, Cornell University. Addresses on agricultural and engineering education and research work in the land grant colleges were given by Dr. Elmer Ellsworth Brown, commissioner of education; President W. E. Stone, Purdue University, and Dr. W. H. Jordan, director of the Geneva Experiment Station. Memorial Day exercises took place on May 30. On Friday morning congratulatory addresses were presented from institutions and learned societies, followed by addresses from the Hon. James Wilson, Secretary of Agriculture; President James B. Angell, University of Michigan; President Henry Clay White, College of Agriculture and Mechanic Arts of the University of Georgia; President Benjamin Ide Wheeler, of the University of California, and President Edmund J. James, of the University of Illinois. In the afternoon there was a procession of delegates, state officials, members of legislature, public school officials, alumni, faculty and students, followed by an address by the president of the United States and the conferring of regular and honorary degrees.

The Hanna chair of political science and the Selah Chamberlain chair of sociology, recently established at Western Reserve University, have been filled by the appointment of Professor A. R. Hatton, of the University of Chicago, and Dr. James E. Cutler, of the University of Michigan.

Nearly one hundred representatives of the University of London, including the vice-chancellor, the member for the university, the principal, deans of faculties and members of the professorial staff, visited Paris this month for a three days' stay, on the invitation of the University of Paris.

Dr. Sidney Dean Townley, astronomer in charge of the International Latitude Observatory at Ukiah, California, and lecturer in astronomy in the University of California, has been appointed to an assistant professorship in the department of applied mathematics at Leland Stanford Junior University. Dr. Townley will assume the duties of his new position with the beginning of the next academic year in August.

Dr. C. H. Mathewson, Ph.D., Gottingen, now of the Massachusetts Institute of Technology, has been appointed instructor in chemistry and metallurgy in the Sheffield Scientific School of Yale University. At the same institution Frank L. Cooper, who receives this year his doctorate of philosophy from the Johns Hopkins University, has been appointed instructor in physics.

G. F. Kay, of the University of Kansas, has been appointed professor of mineralogy and economic geology in the University of Iowa.

Appointments at McGill University have been made as follows: Dr. A. G. Nichols, lecturer in clinical medicine; H. M. McKay, associate professor of civil engineering; Dr. A. D. McIntosh, associate professor of chemistry; Dr. N. Evans, associate professor of chemistry; Professor Paul T. Lafleur, professor of comparative literature and associate professor of English. Dr. John Brittain, professor of chemistry of New Brunswick University, has been appointed to the chair of nature study in the new Macdonald Agricultural College of Ste. Ann, in affiliation with McGill University.

At the University of Manchester Mr. H. Bateman, at present assistant lecturer in mathematics in the University of Liverpool, has been appointed to the newly-instituted post of reader in mathematical physics. Mr. Bateman was senior wrangler in 1905. Mr. C. A. Edwards, Jr., assistant in the metallurgical department of the National Physical Laboratory, has been appointed demonstrator and research fellow in metallurgy.

Dr. August Bier, of Bonn, has been called to the chair of surgery at Berlin, vacant through the death of Professor von Bergmann.